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THOMAS ALVA EDISON

TRIBUTES FORMING A MEMORIAL PROGRAM GIVEN AT THE NEW ORLEANS MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

AN APPRECIATION OF MR. EDISON BASED ON PERSONAL ACQUAINTANCE

By Dr. CHARLES L. EDGAR

PRESIDENT OF THE EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON

I am deeply honored by being asked to address your association, especially upon the subject assigned to me. I note that I am to be followed by three addresses, having to do with the achievements of Mr. Edison, and it is, perhaps, fitting that I should try to give you, in the few minutes at my disposal, a somewhat personal picture of the man as an individual, a friend and an associate. This will, I hope, give a sympathetic setting to the remarks of those who come after me. If I can give you a little of the Edison atmosphere, I think I will have accomplished my purpose.

I have been associated with him or with companies that bore his name for practically fifty years, and I am afraid that, in telling you of some of the incidents connected with our acquaintanceship, I may bring myself too much into the picture. This, I fear, is unavoidable, and I therefore apologize in advance for possibly being too personal.

I was brought up in the Edison atmosphere. I spent my boyhood vacations on my grandfather's farm, located within a few miles of the renowned Menlo Park, where Edison carried on his most important work. We had to pass the laboratory in going to the nearest village, and I came to know the surroundings and the general talk of the neighborhood as to

what Edison was doing. Of course his work did not mean anything to me at that stage of my life, but it was, perhaps, a fitting introduction to some of the things which came later on.

I was a student at Rutgers College in New Brunswick, located about seven miles from Menlo Park, and during my senior year two or three of us went down to the Laboratory one afternoon entirely as a matter of curiosity. A little billiard room was located next to the station, and it was in passing the window of that establishment that I first saw an incandescent lamp burning.

In walking through the machine shop, I saw a group of three well-dressed city men standing alongside one of the benches, apparently talking to a young man in overalls, who was sitting on the bench and swinging his feet. My first thought was that they had happened to stop near where this young man was sitting and that he was inadvertently listening to what they had to say. Some one nudged me and said: "That's Edison." Although I had been in the neighborhood of the laboratory, as I said before, many times as a boy, I had not happened to see him to know him until that day in my senior year.

When I graduated in 1882, I took a postgraduate course in electricity. The instruction was, of course, in those days very crude and the apparatus still more so. We had one or two rather good electric instruments, but most of the apparatus was something that we had made up ourselves. Mr. Edison's laboratory at Menlo Park was in somewhat the same condition.

Our professor in physics was quite an intimate friend of Mr. Edison, and every once in a while I was sent down to Menlo Park either with one of our instruments which Edison wanted to borrow, or to borrow one from him to try on some experiments in our own laboratory. Even on these visits I very seldom saw him, but became quite familiar with his assistants and with the general work in which they were all engaged.

In January, 1883, armed with a letter of introduction from my professor, I went down to Menlo Park to see Mr. Edison and ask him for a job. I knocked at the front door, was sent into the parlor and told to wait. For some time I heard conversation going on in the next room where the family were at breakfast. After a while the conversation ceased and at the end of fifteen or twenty minutes I began to wonder whether I had been forgotten. Apparently I had, because a few minutes later Mr. Edison walked into the parlor, with his hands in the old-fashioned pockets which men wore in those times, a cigar in his mouth, and said: "Where the dickens did you come from?"

I presented my letter which he read and then rather crisply said, "Go down to '65' and see Charlie Clark and tell him I sent you." I was nothing but a youngster and did not have the nerve to ask him for more details. I made some inquiries, however, and the next day went down to what was always called "65." This was the headquarters of the Edison interests, a handsome brownstone house on Fifth Avenue, just below Fourteenth Street, and it was for many years the Mecca of all Edison men. Charlie Clark turned out to be chief engineer of all Edison's work and he sent me down to Goerck Street, which at that time was where the electric dynamos were built.

Clark had fitted up a laboratory which, for those days, was quite elaborate. We must have in mind that, at that time, funds were rather low and elaborateness did not really mean very much. There were, however, a dozen of us, mostly college graduates, all working for glory and not for pay. In fact, the only one actually paid was Mr. Andrews, who was the head of the laboratory.

In the same way that our apparatus was crude, the work in which we were engaged was of the same character. We met with new problems almost every day. Some were solved by the construction of new apparatus and others by new methods of using the old apparatus.

It was during my six months at the Goerck Street laboratory that I came into closest contact with Mr. Edison. I could spend the whole evening telling about the various incidents which occurred which brought one or more of us in direct contact with him. I have in mind two specific events, however, which may give us some insight into this relationship.

All the dynamos were tested by our crowd and were regulated for voltage by a resistance box in series with the field, and more or less resistance was cut in by a commutator device turned by a handle. We got the idea that it was possible to have something automatic, and I personally happened to be the one to whom this work was turned over. We designed an automatic regulator, in which the movement of a small arm was actuated by the strength of magnets. The arm was fitted with a brush, which contacted with the segments of the commutator, and the weakening or strengthening of the magnets pulled in more or less resistance.

It worked very well in the laboratory and we thought we would try it on a new installation in the New York Athletic Club, which had just been built. When the current was turned on in the afternoon, the regulator worked perfectly. When, however, a large block of light was added at one time, the regulator started to race and the lights went from one half candle power to double candle power every ten or fifteen seconds. To say that I was frightened

puts it rather mildly. I grabbed the rocker arm with my hand and managed to steady it so that we could get through the evening with comparatively little trouble. The next morning I went down to see Mr. Edison and told him the trouble. His reply was: "Oh, that's easy. I will send you over something in a day or two which you can put on to remedy the trouble."

The device consisted of a small cylinder with a movable piston, which had a small hole in it. The cylinder was filled with glycerine and sealed. The piston was directly connected to the rocker arm and the glycerine was forced through the small hole as the piston moved up and down. The hole was fitted with a plug, which enabled one to change its size at will, and the speed of the rocker arm was thus cut down and absolutely controllable. It seems rather foolish to explain to this audience a device which is now so well known and so simple, but you must remember that this was forty-eight years ago when most of these problems had not arisen and therefore had not been solved.

After the device arrived at the laboratory, I remember that we all put our heads together and wondered why some of us had not thought of the solution, but it remained for Edison to instantly see the problem and its solution.

As many of you may remember, the Edison system made use of the electrolytic meter for a number of years and until the mechanical meter was developed. This meter read amperes rather than watts and was a very ingenious and in fact a very simple chemical process. A number of bugs developed and I found myself more or less of a specialist on this work. While we were carrying on some of the original experiments, Mr. Edison got out what would now be called a questionnaire. He propounded about one hundred questions and passed them out one at a time to the various men in charge of the meter systems of the companies throughout the country. The replies came to me, and it was my job to classify them and to talk them over with Mr. Edison and see if we could get any ideas which would help us. I was no exception to the rule and he gave me the same questions. I have a very distinct recollection of two of his comments. I do not remember the questions, but I remember one of his comments was: "Edgar, this is no good. You ought to know better. Edison." The other was more satisfactory. He said, "Edgar, this is good. Edison"; and then, in his characteristic handwriting he wrote underneath it—"This answer is so good that I wish you would expand it a little, as I want to pass it along to the other boys." These two experiences may give you a little idea of the relationship which existed between him and those in his personal employ.

In 1884 we made a very elaborate exhibit at the Electrical Exhibition in West Philadelphia. I was there for three or four months constructing, operating and demolishing the work. Mr. Edison was a constant visitor. He seemed to take much interest in the exhibits, not only in his own but in those of other exhibitors. During its continuation it was visited by many foreign engineers, and on these occasions they were invariably accompanied by Mr. Edison.

I remember a discussion which took place one afternoon between Sir William Preece and Mr. Edison on some detail of the system which Mr. Edison was showing. They differed in their views, and it was always a source of great satisfaction to me to remember that time proved that Mr. Edison was right.

In 1885 there was a sufficient number of Edison stations established throughout the country to warrant the formation of an organization, bringing these people together. It was called the Association of Edison Illuminating Companies, and I do not believe there was a single meeting that Mr. Edison missed for at least twenty years. He, of course, was not able to take very much part in the discussion, as he was too deaf to hear well what was going on. He got a sufficient idea, however, to call us together informally between meetings and discuss privately most of the subjects which had just been presented publicly.

In some respects the most interesting part of these conventions were the trips to the convention cities. If they were any distance from New York, we usually had a private train and Mr. Edison was the life of the party. The crowd would group around him in his drawing room and he would tell stories by the hour, some of us even sitting on the floor in order to get close enough to hear what he was saying.

As I tell you this story, it does not seem as if I came in very close contact with him, but as a matter of fact, the opposite was true. His deafness prevented one from getting really intimate. In carrying on a conversation with him, it was rather embarrassing to shout so loud that every one in the room could hear you, and many is the time that I wished that we were by ourselves so that I could express myself more definitely than I could in what was really a public place.

On one of the hottest days in June, 1930, I had to go out to the laboratory and present Mr. Edison with a Memorial which had been passed by The Society for Electrical Development. After making the presentation and chatting for three or four minutes, Mr. Meadowcroft, Mr. Edison's secretary, suggested, as he usually did, that we go outside and have our photographs taken. This picture was published in the Boston papers on the day of Mr. Edison's death, headed, "The last photograph taken of Mr. Edison."

He had on what we would call a pongee suit, al-

though I think he spoke of it as China silk, which it probably was. He reached down, took my hand, and asked me to feel of it and said: "Did you ever see anything quite so thin?" He pulled his trousers nearly up to his knee and said: "And I haven't got anything on under it."

The late Elmer A. Sperry, who was president of the American Society of Mechanical Engineers two years ago and who took part in the fiftieth anniversary celebration to which I later refer, in recounting some anecdotes of Mr. Edison, told the following story, which illustrates the side of his character which those who knew him well were accustomed to see:

"Mr. Edgar has given us all a beautiful picture of Edison, the youth in overalls, swinging his legs from a work bench at Menlo Park. I want to draw a little picture of Mr. Edison at eighty-two.

"When he came in he spied me with a cane. He said: 'Sperry, what are you doing with that cane?' I tried to explain that it was only a habit of mine that I had recently acquired. He said: 'I have no use for a cane, now see me kick!' He jumped up out of his chair and kicked higher than his shoulder instantly.

"Of course we were all wonderfully amused and laughed. I believe I applauded. He said: 'Well, if you laugh at that, I will give you something to laugh at. I was away on one of these here vacations.' He did not speak in very respectful terms of a vacation, although I can not understand how he could resist his friend, Mr. Ford. I think he was the one who teased him into having his first vacation. He said: 'While on one of these here vacations, I kicked like that and Mr. Burbank tried to imitate me and he fell down on his back and hurt the back of his head. Ha! Ha! Ha!'

"He laughed as though he were a boy of ten. We could all see that the picture of Burbank picking himself up out of the leaves and rubbing the back of his head must have been very vivid in his mind, as he recalled it, because he laughed until the tears ran down his face and we shared in his merriment."

Mr. Edison always kept up the acquaintanceship with those whom he called his boys, and as a result of this close relationship, some of his early associates organized, in the year 1918, what they called the Edison Pioneers. Those who have been associated with Edison up to and including the year 1885 were eligible to membership. There were, perhaps, 125 to 150 who joined the association and there are remaining in this class to-day 106 members. We later broadened the organization to take in associate members, those who were connected with Mr. Edison between 1886 and 1900. This class was limited to 150. There are still living 97. We also authorized a descendant membership, consisting of the sons and daughters of either the members or the associate members. There are thirty of these.

It has been our practice to have a dinner on Edison's birthday, February 11, and we have usually had from 150 to 250 present, consisting of the members and their families. One of these dinners was in Mr. Edison's own house, one or two in one of the upper floors of his laboratory, and the remainder in either a New York or a Newark hotel. Until within the last three years Mr. Edison and his entire family have attended these reunions, and he has rubbed shoulders with those who were with him in those early days. For the last two or three years he found it necessary to go to Florida on account of his health before the cold weather set in, and the meetings had to get along without him.

It is on occasions like this that the old acquaintanceships have been renewed, not only between Edison and the boys, but between the boys themselves. For example, at a meeting of the Pioneers held in Orange the day before Edison's funeral, at which 150 were present, I met one man whom I had known intimately but had not seen for forty years. At these meetings Mr. Edison seemed to renew his youth and became really one of the boys himself. It was under these circumstances that we all came to call him "The Old Man."

There is one thing that you people will have to bear in mind in thinking of the relationship between Mr. Edison and his associates and that is his extreme deafness. For the last two or three years he had been what I should call absolutely deaf. He never learned lip reading, neither was he willing, until very recently, to try any of those mechanisms for the deaf. The result was that his conversation with his friends, with the possible exception of his own family, were quite largely carried on by writing on slips of paper.

When I went out to see him last year with The Society for Electrical Development Memorial, I had to write on a piece of paper, just how I happened to be there, and had to answer in the same way any questions which he asked me about the society. This made it not only difficult, but really embarrassing to try to carry on any conversation with him. Curiously enough, he seemed to understand his wife perfectly, but this was not in any sense lip reading, as she had to put her mouth up close to his ear when communicating with him.

This infirmity sometimes had its ludicrous side. I remember about twenty or more years ago, when a dinner was given to Lord Kelvin, Sir William Thompson, at the Waldorf in New York, Mr. and Mrs. Edison were present, and in the speech-making which took place some very complimentary remarks were made by the chairman regarding Mr. Edison. Everybody, including Mr. Edison, applauded vociferously.

His wife leaned over, pulled down his head, and whispered something to him. He immediately blushed, sank down in his chair and almost disappeared under the table. While he was very much embarrassed, he saw the joke, as did everybody else.

Mr. Edison was given the honorary degree of Ph.D. by Rutgers College quite early in life. Some ten years ago the question came up of giving him the degree of doctor of science. I happened to be on the honorary degree committee, and it developed that two or three years prior to that time he had been approached by one of our leading trustees and had turned down the suggestion with the general expression—"What's the use?" We agreed to make another attempt with considerable hesitation, but after talking the matter over with Mrs. Edison and his secretary, I put my attempts in a somewhat different way from that in which he had been approached before.

I practically said to him: "Of course you don't care anything about this degree. It doesn't mean much to you, you have so many, but I want you to look at the other side of the picture. Rutgers is located within ten miles of where you did your most noted work. You have become a Jerseyman by residence, and Rutgers is distinctly a Jersey institution. More than a dozen Rutgers men have gone into the employ of you or your associate companies upon their graduation. I happen to be one of them. I think you owe it to us and to the college to let us show our appreciation of you." This finally won him over, but even then my job was only half done. He has always had a great habit of forgetting appointments, or rather of becoming so absorbed in his work that he has neglected his appointments. I reported back to the college that he accepted, but that I would not guarantee his presence at the commencement exercises.

When he found that he had to drive over to New Brunswick he demurred again, but finally things were smoothed out and he started for the college. The academic procession was to start at eleven o'clock. At ten minutes of eleven he apparently had not arrived. I was beginning to get very much disturbed and wandered around the campus, thinking that he might have been sidetracked by some acquaintance and had forgotten where he was to meet the other delegates. I finally drifted into the robing room and there I found him, sitting in an armchair way back in the back of the building. I rushed up to him and his only comment was, "I didn't like the looks of that crowd out there, so I sneaked in the back door."

At the collation which succeeded the ceremony, Mr. Edison sat, as he always did on occasions of this kind, looking a trifle bored. He did not hear what was going on and acted as if he wished the thing were over. Finally the glee club grouped themselves around him and commenced to sing some of the college songs. You never saw such a change in a man. He kept time to the music with his feet and with his knuckles on the table and showed very clearly that he was finally thoroughly enjoying himself. As he drove away from the campus that afternoon, Mrs. Edison turned to me and said: "I am so glad we made him come. I think he has had a wonderfully good time."

The incidents which I have recited may give you a slight idea of the kind of a man he was to those who were associated with him personally.

At the annual convention of the National Electric Light Association, held in Atlantic City in the summer of 1929, a day was set aside as "Edison Day." It was, as you know, just prior to the fiftieth anniversary of the invention of the incandescent lamp. It was my good fortune to preside and I opened the meeting with an address which I called: "The Inspiration of a Name." I am not going to read it to you entirely, but there are a number of things in it which, although written before his death, are appropriate to be repeated now. These, I hope, will give you my conception of the other side of the picture. Speaking of the anniversary of the incandescent lamp, I said:

"There will be those who will stress the inestimable value of this invention and his meritorious work leading up to and succeeding its accomplishment, while others, like myself, will be more inclined to consider the character of the man himself, and discuss the individual rather than his achievements."

The pages of history are illuminated with the names of those who have attained renown through some distinguished service for the welfare of mankind. I shall classify these illustrious personages into two separate and distinct groups.

In the first group the much larger number devoted their individual efforts to a cause which was dear to the hearts of their fellow men.

Washington, the beloved Father of His Country, is a shining example of this type. He was called into service during a great national crisis which existed even before he responded to the summons. It may be said to his everlasting credit and honor that he carried out his task to a most successful conclusion. He found a struggling colony oppressed by the heel of a tyrant; he left a peaceful republic happy in its hard-earned freedom.

Lincoln, the Great Emancipator, is another outstanding example of this type of famous men. He was called to preserve a nation. He not only threw off the shackles of the oppressed, but he perpetuated a union which was threatened with disruption and disaster.

Throughout all times and in all nations of the world there have been numerous other examples of

this devoted type. Many of these, as in the cases of Washington and Lincoln, dedicated themselves to the preservation and upbuilding of their country, while others were inspired to action not by love of country, but through their consecration to religion. Contrast with these others who have used their talents in an attempt to break down and destroy civilization. These are the Caesars and the Napoleons—warriors who have risen to fame as the conquerors of hostile nations, rulers who have reared vast empires to satisfy their ambition and lust for power. The former type, working for the upbuilding of some lofty principles, and the latter, disrupting the order of the world to satisfy their selfish desires, have all obtained the plaudits of the multitude. In almost every case they had been working for a cause, whether it had for its object creation, preservation or destruction.

It is most difficult to analyze the thrill and emotion with which we look back upon the achievements of these striking personalities to determine how much of it is due to their individual efforts and what part is the result of an interest in the cause which they represented. The two are so clearly associated that, unconsciously perhaps, we have lost sight of the cause and have placed the individual upon the pedestal, due to our fascination for the man himself.

The other group to which I refer includes those who have risen to fame through accomplishments which were the result of a thought or an idea originating in each inner consciousness. They were not called to preserve existing conditions, to introduce reforms, or to advance the interests of the church or state. They were pure individualists who assumed their tasks, not in response to a popular demand for a leader to accomplish some desired result, but inspired only by their own visions. They had a conviction that there was some specific object which they could accomplish, and they carried their work to a successful conclusion without outside advice or assistance.

The poets, the philosophers, the painters, the musicians and the scientists are all men of this type. They have delved into the mines of nature's mysteries and have brought to light gems of truth and beauty which have added to the wisdom and culture of the ages, and it remained for Edison to discover the source from which, at his magic touch, was created a new sun for a new world, dispelling darkness and bringing added comfort into the homes and revolutionizing the life and methods of a grateful world. For him nature revealed her hidden secrets, and through him a new industry sprang into being. After centuries of unconscious waiting, the world awoke to realize that the dark watches of the night had wasted away and a new day of light and gladness had dawned for mankind.

I shall not attempt to recount the practical results which have followed this invention. I am leaving that as a theme for others. The thought which is uppermost in my mind has to do with Edison, the individual and the friend, rather than with Edison, the inventor and the discoverer. There are many members of the Edison Pioneers still carrying on and I feel that their thoughts are running parallel with mine, and that they will agree with me when I state that we are inspired not so much by what he has done as by what he really was. Those of us who have been closely associated with him and knew him intimately have received an inspiration which, though difficult to describe, is nevertheless profound and enduring. While we have been amazed at the volume of his achievements, and spellbound by his energy and perseverance, we have been especially touched by the warmth of his affection. Though he may be acclaimed a leading scientist and inventor, though he may be pointed out as the highest type of American citizen, those of us who knew him best will ever proclaim him, above all, a staunch and faithful friend.

Always modest and of a retiring nature, he has not desired fame or honors, although his fellowmen have praised him for his integrity of character, have honored him for his achievements and loved him for his self-sacrificing regard for others. Throughout his whole life no labor was too great to be undertaken for the accomplishment of a purpose when once his mind was determined to pursue it. Truly his life was a life of service, and we of the utility industry, whose basic principle is service, find in his life and work an example which it is an honor to follow. When confronted with a problem, the solution of which taxes our utmost powers, we may be encouraged to persevere when we remember how Edison conquered the apparently unattainable by dint of hard work, untiring zeal and unlimited perseverance. While we credit Edison with a remarkable degree of genius, we have his own modest testimony that much that he had accomplished has been due to hard work and perseverance; though we lack the natural powers which he possessed, we may be inspired by his example to accomplish much in the world if we apply ourselves to the tasks which are ours with his determination and his willingness to labor. To follow is the lot of the multitude; to lead is the privilege and responsibility of the master mind who dares to stand alone, if necessary, while adhering to the principles which he believes to be sound and logical.

Edison has blazed the trail through unknown wilds, while others looked on with unbelief. His was the task to lead the way and true to his high calling, he emerged with the fruits of victory amid the plaudits of those who had been unbelievers.

In looking back to review the wonderful results

which he has accomplished during his fourscore years, we are again astounded that this man of mature years, but young in mental capacity and in resourcefulness, has within very recent years taken up a new line of endeavor and, we have every reason to believe, has brought to a successful conclusion an important development in one of the leading commercial industries of our times. Apparently there has been no limit to his possibilities. When those of us who knew him intimately and were inspired by his personality shall have faded from memory, the name of Edison will still live and grow with the years, an inspiration of the sons and daughters of every tongue and every nation who see the light and render thanks to him who invented it.

There are undoubtedly many of you who are listening to me to-day who either do not appreciate or who underestimate what this means. All I can say is that I am sorry for what you have missed. While all of us engaged in the public utility business are proud of our industry and really feel and believe that it is one of the most important as well as interesting businesses in the world, I want you to realize that there are some of us, perhaps few in number, who have a deeper feeling than that felt by the greater majority. It is a feeling of pride, experienced not so much on account of what Mr. Edison himself has done as for what he has inspired us to do. I do not think that any one could have been associated with him for a generation and not be influenced, perhaps unconsciously, by the spirit which has actuated him. It is hard to put into words just how we feel. Personally, I feel like bowing my head and being thankful that my good fortune enabled me to live my life in the atmosphere he has created and under the inspiration of his name.

EDISON'S CONTRIBUTIONS TO SCIENCE AND INDUSTRY

By Dr. F. B. JEWETT

VICE-PRESIDENT OF THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY

To undertake, within a few weeks of his death, anything like a judicial appraisement of Thomas Alva Edison in the matter of his contributions to science and industry is to attempt the essentially impossible. Even had he been a man of lesser stature, insufficient time would have elapsed in which to develop a fair perspective of his achievements. In Edison's case a longer period than usual must ensue before we can see clearly just how his work has fitted in with that of his contemporaries and into the foundations on which subsequent structures of science and engineering and industry grounded in engineering have been built.

Despite the limitations which the undoubted greatness of Edison imposes on us at the moment, it is nevertheless fitting that a tribute to him and his work should be made at this the first meeting, following his death, of the American Association for the Advancement of Science. Clearly any tribute to the man or any appraisement of his work, if it is to be of real worth, should be by those having the right of classification among Edison's peers in his own field. In this respect I feel myself incompetent, and my sole justification for appearing before you is that I may have a right to voice an opinion of those who, while not of Edison's stature, were nevertheless his contemporaries and workers in the fields which he enriched by his contributions.

Because Edison's name has been a household word throughout the world for nearly half a century—a name to conjure with and to many that of a somewhat mythical personage against whose inquiry no doors of science were locked—one runs the distinct risk of overvaluing Edison's real achievements. On the other hand, one runs equally the risk of underrating these same achievements in endeavoring to avoid the obstacles of the first dilemma. If therefore any of you should feel at the conclusion of these remarks that I have erred in my appraisal, I trust you will appreciate the situation in which I am placed in attempting to do now, in respect to a man for whose attainments I have the highest regard, something which would best be done ten or fifteen years hence.

While the titles for Dr. Millikan's appraisement of Edison and mine are the same, we have agreed to approach the matter from different angles—he from the point of view of fundamental science, on which all engineering is founded, and I from the point of view of those practical applications of science which are peculiarly the province of the engineer.

Whatever additions to fame and recognition may have come to Edison in his more mature years, a survey of his achievements as an inventor, engineer and pioneer in industries grounded in engineering makes it clear that he did relatively little during the last forty years of his life to add luster to the fame of his earlier achievements. As a matter of fact practically all Edison's claim to the title of the greatest

American inventor grew out of his work and achievements in the decade between 1870 and 1880. One has but to look over the astounding list of his accomplishments in this ten-year period to appreciate the things which raised him to such a lofty and secure pinnacle—a pinnacle both lofty and secure not only in the estimation of his fellow Americans but in the estimation of men everywhere. In the years which followed this prolific period, and particularly in the decade between 1880 and 1890, Edison's contributions, while vast and important, were essentially different from those of the years in question. They were in the main contributions to the successful employment of his earlier work and were devoid of the brilliance of imaginative insight then so characteristically evidenced.

Nor is it surprising, when one comes to look back on Edison as he was at that period and on science and engineering as it then existed, that he should have been so enormously productive during these few years and that subsequently his life should have run in quieter waters, so far at least as concerned the making of substantial additions to the tools of engineering and industry.

Despite the fact that Edison was imbued to the highest degree with that characteristic which is the hallmark of science, namely, the characteristic of subjecting every theory to the acid test of controlled experiment, he lacked nevertheless the formal training which we normally associate with men of science and engineering. As an offset to this lack of formal training he had an intuitive insight which was unique, an insatiable curiosity and a dogged determination to overcome all obstacles. All these were associated together with a physique which permitted a punishment of the body that few men could have undertaken or stood.

In the decade of the seventies Edison was in his prime not only from the standpoint of his physical being but also from that of his creative imagination. Fortunately for him and for the world in which he lived, the development of science and engineering had during this era reached just to the point where men like Edison were required and where they could find the fullest possible play for their particular genius.

A great store of new facts in what we are now sometimes wont to consider as the grosser physics, in distinction to the more ethereal physics of our present time, had been assembled. To make these facts available for the everyday uses of society required just such an inventive genius and engineer as Edison proved himself to be. It was characteristic of Edison that he saw and seized the opportunity which was his to his own and the world's very great advantage. That the years of his life subsequently were devoid of spectacular achievements in the field of invention is not surprising. All the forces of life and society were against this. Fecundity in ideas is peculiarly the normal characteristic of man's earlier years. Further, in Edison's case—practical man that he was—the carrying out of the intricate details which were the normal fruitage of his own creations demanded a vast tax on his time and energy, which left him little of either to devote to new and untrodden fields. Also, as science itself developed, the practical application of new knowledge came to require a type of training which Edison did not possess.

That this is so, and that Edison during the last part of his life was not the same conspicuous producer of new things that he had been in his early manhood, is not in any way a detraction from his real greatness.

Coming back now more specifically to the things on which it seems to me Edison's claim to greatness is firmly grounded, we find them to be four in number. First, his work in the field of telegraphy in the very late sixties and early seventies; second, his production of the carbon telephone transmitter in 1876; third, his invention of the phonograph in 1877, and finally his development of a practical incandescent lamp and of the system of electrical generation and distribution needed to employ it practically, in 1879 and in the years immediately following.

Of the four, the invention of the phonograph is unquestionably his greatest single achievement from the standpoint of daring imagination, while his development of a practical incandescent lamp and of all the adjuncts that were required to make it commercially available, was his greatest engineering achievement. Since this last achievement marked the inception of a great industry which has carried his name to the far places of the world, it is probably the thing by which he will be longest and best known.

Outside the ranks of those in the communication field itself, the world now hardly thinks of Edison as a great contributor to the development of distant electrical communication. This is due to the fact that despite the importance of his inventions to the art of the period in which they were made, they have with the passage of time, for the most part, now passed into the oblivion of ancient things. Other developments and other applications of a science which did not exist when Edison was a young man have displaced them. The Edison quadruplex and the various other things which he devised were nevertheless marvels of ingenuity in their time and, while they lasted, greatly to the advantage of telegraphic communication and its development.

In the field of telephony Edison's work in connection with the development of a carbon telephone

transmitter—that device which was needed to give a mighty forward impetus to Bell's great fundamental invention—has had a more lasting life. Carbon transmitters in one form or another are still the basic instrumentalities for translating sound vibrations into electrical vibrations. Nevertheless, Edison touched the telephone art only at a point, and except for the lasting results which grew out of this contact, he did not influence the development of this art as he did that of the electric light or phonograph arts.

In his invention of the phonograph Edison displayed an imagination, a skill and a perseverance of the very highest order. This invention alone might well have inscribed his name indestructibly in the history of America and of the world. Just as Alexander Graham Bell's name will go down through the ages as the man who made possible the instantaneous transmission, to a distance, of the human voice, so the name of Thomas Alva Edison will go down as that of the man who first made possible the preservation in time of the human voice.

At a time when phonographs, both acoustical and electrical, are an everyday commonplace, and where most of those in the world who are less than forty years of age can hardly conceive of life without the phonograph, it is difficult to appreciate the degree of daring which Edison displayed in even imagining that he could imprison such a fleeting thing as the energy of the spoken word. Equally difficult is it for the average man of to-day to conceive of the daring involved in imagining that out of the prison thus created could come, at some remotely distant time, a reproduction of ancient words, possibly those of men long dead, with the full vigor and clarity of the original speech.

With the successful completion, in the late seventies, of his long and arduous quest for a suitable filament material and its incorporation in a properly designed and evacuated glass container, Edison turned a hitherto scientific oddity into a practical and commercial light-producing instrument. The carbon filament incandescent lamp as it came from Edison's hands contained in itself enough of ingenuity, painstaking research and clear insight into fundamental requirements, both scientific and practical, to have insured him a permanent place in the history of electrical development, had he done nothing else in the field of electric illumination. For Edison the incandescent lamp was but an incident, however. In itself it was useless for the purpose he had in mind. It was merely the first link in the chain which he was to forge in creating a great new industry of immeasurable benefit to mankind. The forging of this chain was to afford Edison ample opportunity to show himself a great engineer as well as a great inventor, and was to consume a major part of his time and energy for a decade or more.

As an inventor and experimentalist he had produced an ingenious and potentially valuable illuminating device, but the electrical art of 1879 was almost entirely devoid of the things to make it commercially available. Seldom has the creator of so perfect a new tool found the field so bare. More seldom still has one done so much to create an art around and for his tool as Edison did in the ten years following 1879.

Generators, systems of distribution and utilization, switchboards, auxiliary equipment and adjunct devices, large and small, in vast profusion flowed unceasingly from Edison and the group of intelligent young men with whom he surrounded himself. In the welter of this torrent of new things no one will probably ever know just who was initially responsible for each and every one of them. Three things are certain, however: first, Edison himself was the creator of the principal items; second, his was at all times the guiding mind and the driving force; third, the group of men who later came to be known as Edison Pioneers, and who were and in large measure still are dominating factors in the electric light and power industry, were youths of his discerning selection.

No better proof of the fundamental soundness of Edison's work in those early days of electric illumination is required than the knowledge that the basic things of the art he then developed are still the basic things of the vaster art which has evolved from it. New devices and applications, many of them involving scientific knowledge which did not exist when Edison was pioneering, have been made in inventions and uses, but still in its fundamentals the art of electric illumination is the art as Edison created it.

Nor was this art merely the result of happy chance shot through by flashes of brilliant imagination. Brilliant imagination there was in plenty, but at the bottom it was the result of clear thinking, untiring labor, faith and a willingness to face facts of every description and mold them all to an ordered progress.

Only a great engineer as well as a great genius could have done the things which Edison did in the electric light and power field. That his work and his preeminence were recognized by his contemporaries is evident when we come to examine the roster of names which make up the great electric light and power companies. Many of the most brilliant stars in the galaxy of these organizations have the name "Edison" as part of their title. Had these names been chosen in recent years one might attribute the choice to some desire to capitalize the popularity and mystery which has come to be attached to Edison and his work. The fact that the names go back in most instances to the very early beginnings of the electric

light and power industry, and so to a time when Edison was but little known outside of his own field, makes it clear that within that field he was even then recognized as master.

If one were writing a complete biographical appraisal of Edison and his works, pages could easily be filled with descriptions of the tremendous array of things which he produced and patented, and of the wide range of his interests. In so short a note even as the present one there is great temptation to expand the list to include a few more items, notably his work in the motion picture art. Some of this work is but little inferior to that which seems to me to constitute Edison's principal unassailable claim to fame.

The amazing variety of the things which Edison did and the fact that he seldom made contact with any art without contributing something to its advance lead one to speculate on what might have happened to the development of some of these arts had Edison concentrated his attention on them during the years of his greatest productivity.

In closing this brief appraisement of the engineering side of a man for whom I had the most sincere regard, I can not refrain from voicing a bit of regret that during his evening years his name should have been so frequently associated with inconsequential things or with personal idiosyncrasies, with which we are all amply provided. While these associations subtracted nothing from the judgment of men who knew Edison's real worth, they did unquestionably portray a great man in a somewhat false and belittling light to vast numbers of a younger generation.

EDISON AS A SCIENTIST

By Dr. ROBERT ANDREWS MILLIKAN

DIRECTOR OF THE NORMAN BRIDGE LABORATORY OF PHYSICS, CALIFORNIA INSTITUTE OF TECHNOLOGY

I AM asked to say something about the scientific qualities and achievements of Mr. Edison. But from my point of view the scientific influence of any man is so interwoven with his character, with his mode of thought, with his outlook on life as reflected in his acts, his words and his daily walk among his fellows that I prefer to let what I say about Mr. Edison's science grow out of a somewhat broader consideration of the qualities which made him the commanding figure that he was and that, as I think, he always will be.

I should like to raise first one very fundamental question. Is it merely an accident, a coincidence, that the two greatest scientists of the nineteenth century, the two who, the world over, would be first named as the most significant creators of the age of electricity with all that it has meant to the world, namely Michael Faraday and James Clerk Maxwell, were also great souls, possessors in peculiar measure of the virtues which in all times and all places have been regarded by mankind as the most fundamental, namely, modesty, simplicity, straightforwardness, objectiveness, industry, honesty, human sympathy, altruism, reverence and a keen sense of social responsibility. These qualities arise, I think, from one great all-inclusive quality, namely, balanced but penetrating and objective judgment, *i.e.,* from a correct understanding of relations between phenomena, social as well as physical, including that of one's own position in the scheme of things: and this quality, this perception is precisely what gives the great scientist his insight and his effectiveness. Smart rogues, clever scoundrels, gifted egotists, exist, no doubt; but do they do the things that live? I suspect not often. Certainly history is replete with the names of great scientists who have also been great souls—Copernicus, Leonardo da Vinci, Newton, Kepler, Faraday, Helmholtz, Pasteur, Maxwell, Kelvin, Lorentz, Einstein. What a galaxy of greatness not merely as scientists but as men!

Had Edison their quality and was this the reason of his greatness? I did not know him intimately, but I saw enough of him to be sure that I saw some of their virtues. He had not the educational background of most of them, and might therefore have been expected to be somewhat wanting in their breadth of vision, but the very exceptional minds—the really great—do not need the schools, for they appreciate what educational opportunity means, and have the capacity to become educated without the aid of the schools. This quality—the *sine qua non* for a scientist—namely, the appreciation of one's own ignorance and limitations coupled with the eternal urge to learn, and the will and power to follow that urge—I myself had the opportunity to see in Edison.

During the war when we were both engaged in Washington I spent an evening or two with him. He was then, at the age of seventy and more, reading some of the newer books that were then appearing in the field of pure science, and asking intelligent questions about them, too. His ears were gone, but there had been no crystallizing of his mind, such as occurs with some of us before we are born; with others, especially with so-called men of action, before we are forty; and with most of us, even with those who have learned to combine the art of knowing with

the power of doing, by the time we are seventy. That Edison above all men retained his essential modesty, simplicity, intellectual honesty and willingness to learn, in spite of the disease to which it was his misfortune to be exposed in early life and continuously thereafter, is, I think, the best proof that we have of his real greatness. I refer of course to the disease which attacks and almost always lays low football heroes, movie stars, presidents and kings—the disease of publicity and adulation.

There seems to be no known method of inoculating human beings against that disease. Only the really great, apparently the extraordinarily great, are immune. One can set it up as a well-nigh universal law that "human nature can not stand too much corn," and but few men in our American history have had so much of it as did Edison. Did it go to his head, as it has done in the case of so many others who have been *almost* great? I could see no indication of it. The fact that his name became probably the best-known one in the United States, that commercial electrical companies from one end of the country to the other adopted it as their trademark, as a guarantee of their quality, that sycophants and exploiters swarmed about him—all this apparently left him practically untouched.

Nor was this merely the impression which he made upon me, one individual scientist. I well remember when Professor Fabry, of Paris, the head of the allied scientific mission sent to the United States by the Allied European Governments during the war, came back from a visit with Edison and said, "Simple, direct, intelligent, unspoiled—a very much greater man than I expected to find in view of the way his name has been exploited and the kind of influences with which he has been surrounded." So much for the fundamental qualities which make true greatness in a scientist.

As to his actual accomplishment in science. It is customary to make a rough-and-ready distinction between pure science and applied science, and it is indeed possible to set up definitions which bring out the difference as applied to a given time and place, but in the ultimate analysis all increase in knowledge is directed toward one single end, namely, the increase in human satisfactions. When one talks about pursuing knowledge for its own sake he is only asserting his belief that it is important to stretch the mind of man, to feed his intellect and his soul as well as his body. At one time and place, for example in time of famine, the latter, *i.e.*, the material need, may be the all-important one; at another time and place, for example, in a time in which the capacity for producing material things is superabundant, the former, *i.e.*, the spiritual need, may be a vastly more crying one. In the United States the period into which Mr. Edison was born was one which called loudly for the increase in material facilities. It was a new and a largely undeveloped country calling violently for transportation, for communications, for the means to make one man's labor produce the maximum of goods. Edison heard that call, saw that need, and bent his matchless energies and capacities to meet it. Our country through our patent laws had striven to stimulate our people in just that direction. Hence with his gifts and his background it was practically inevitable that his contributions to human progress should have found their outlet almost entirely through the patent office.

Had he been born to-day when, through the applicatoin of science, mankind in the United States can produce more food that it can eat, more clothes than it can wear, more buildings than it can occupy, I venture to estimate that he would have seen, as you and I see so clearly now, that the satisfactions that come from the stretching of the human mind, through the growth and the dissemination of knowledge, and through the giving of leisure for the acquiring of the knowledge of how to live more wholesomely, more inspiringly as a race than we live now, has pushed itself to the front as the greatest of our present human needs. New occasions have indeed taught new duties. Having fed his body, man's next great need is to feed his intellect, his heart and his soul. In a word, the relative importance of pure science and applied science in the United States has undergone a change since Edison was born and that for two reasons, first, because all applied science grows out of pure science, and if the springs that feed the river dry up presently there will be no river left; and second, because having learned how to feed and clothe the body the *art* of living, which comes from the growth and spread of knowledge, is now our greatest need. "Crescat scientia, vita excolatur"—"Let knowledge grow that life may be enriched."

Thus far I have said nothing about Mr. Edison's specific scientific accomplishment as distinct from his engineering and industrial contributions. There were, however, two of them. The so-called Edison effect was discovered in 1883 and patented in 1884. It underlies in a way the whole vacuum tube art with all that it has since been found to mean for the life of the race, but nothing came of it then because neither he nor any one at that time understood it, or had the time, or the urge so conspicuously displayed by Faraday, to stop and find out what it meant; *i.e.*, why nature worked that way. The credit for finding out goes in this case to Edison's scientific successors two decades later.

The second scientific accomplishment is enough by itself to make any man immortal, for to Edison alone

belongs the credit of conceiving, and showing how mortal man may speak with his living voice directly to all the generations that follow after him. Could we to-day but hear Socrates and Marcus Aurelius and Shakespeare and Newton and Franklin and Goethe and Faraday and Maxwell, as our children and our children's children through the long ages will be able to hear their counter-parts of to-day and of all the times yet to come, would we not build another Promethean legend around that deed akin to that of stealing fire from heaven and bringing it down to men. That man has lived and worked and walked on earth with us in our generation. Thomas A. Edison is his name.

EDISON'S LABORATORY IN WAR TIME

By Dr. KARL T. COMPTON

PRESIDENT OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

DR. JEWETT and Dr. Millikan have discussed the importance to science of some of Mr. Edison's inventions and investigations. My own talk will, like Mr. Edgar's, be based on a personal contact with Mr. Edison and his laboratory, and through it I wish to give additional details to the picture of Edison as a workman and as a scientist.

Immediately following the declaration of war in 1917 Mr. Edison telephoned President Hibben, of Princeton, requesting him to send to his laboratory four scientists as volunteer war workers. I went with three of my colleagues from the department of physics and remained for the months required to bring to a conclusion the problem which was set for me by Mr. Edison.

All through the war the newspapers published frequent stories of Edison's war activities and of the secrecy in which they were carried out. One story which I remember described experiments carried on in the dead of night on the top of a mountain with armed guards posted all around the base. Whether these stories are true or not I do not know, but I do know that Edison's research laboratory was actively at work and that contact with this work gave me a vivid picture of Edison and his methods.

Immediately upon meeting Mr. Edison and barely taking time to say "how do you do," he took out his pencil and began to describe a problem which had been put up to him by the Naval Consulting Board—the problem of increasing the efficiency of the driving mechanism of a torpedo so that a larger amount of explosive could be stored in it without changing its range or size. He gave me a very brief history of the development of the present torpedo, told me the conditions which an improved torpedo would have to satisfy, and told me to come back to see him when I had a solution.

In about three weeks I reported to him that I had found three fuels which seemed to offer possibilities. He disposed of these solutions in three sentences: "Fuel A can only be obtained in Germany. Fuel B has been tried but discarded because of the danger of explosions. Fuel C, which included wood alcohol, is no good because the sailors drink the d— stuff."

So I went back for another couple of weeks and returned with a fourth solution. Mr. Edison took the papers, looked over the calculations, muttering the while to himself, and then said, "When I don't understand work like this I get two men to work at it independently. If they agree, maybe it is all right; if they don't agree, I get a third man. Go up into room — and see whether you agree with a young fellow from Columbia University whom I put to work on the same problem."

On interviewing this Columbia scientist I found that we agreed entirely as to method but disagreed radically as to conclusions. Whereas I had found very few fuels possibly superior to those which the Navy was using, he had found that almost every fuel was superior. On looking over his work, however, I found that he had based all calculations on a formula for alcohol, C_{12} H_{22} O_{11}, which is sugar. In other words, he had been actually finding out what fuels would be better than sugar for driving the Navy's torpedoes. When I asked him where in the world he had got that formula for alcohol he said, "You see, I am a mathematician and not a chemist so I went to the library," and with that he showed me an ancient book on chemistry, in which C_{12} H_{22} O_{11} was actually given as the formula for alcohol.

Following this conference, Mr. Edison arranged for me a visit to one of the naval torpedo stations, where the calculations were checked by the torpedo engineer and the work was left in the hands of the Navy, with what results I do not know.

A second investigation illustrated Mr. Edison's great fertility and imagination. There had been numerous demands for the development of a supersensitive microphone for detecting enemy operations by night or under the ground or beneath the sea. According to Mr. Edison the ordinary carbon granule microphone had too high a resistance, and he wanted to try metal granules, "But," he said, "metal granules

are too blamed sluggish. We must make them lighter." He so devised this scheme: First he got a large supply of hog's bristles from a local brush factory; then he plated these hog bristles with a great variety of different metals. Some of them were plated by the electrolytic process, which he used in manufacturing his phonograph records; others were plated by cathode sputtering in a vacuum; and still others by the condensation of evaporated metals. When each of these hog bristles had plated on to it a thin coat of metal, the bristles were cut up into tiny lengths, each about a hundredth of an inch long, by a microtome such as is used in cutting specimens for microscope slides. These tiny little cylinders were then placed in a bath of caustic potash, "the stuff men dissolved their murdered wives in," said Mr. Edison, which dissolved out the hog bristle and left a tiny hollow cylinder of metal, shaped like a napkin ring, and these were the metal granules which were used in place of carbon for the experimental microphones. How well they worked I do not know, since I did not see the conclusions of the test. My guess would be that they did not work as well as carbon, since scientists think that there is a peculiarity in the structure of carbon which makes it particularly effective for microphonic purposes. It was one of Mr. Edison's characteristics, however, that he would not let his own, or any one else's preconceived ideas stand in the way of making a test. This practice certainly led to many futile experiments, but it is equally true that it led to some successful discoveries which caused the scientists to revise their earlier ideas. Edison was not ignorant of what others had done, even though he often appeared to pay little attention to it. A great reader, frequently, before starting, he read everything which had been published on the subject.

Typical of another method of Mr. Edison's work were experiments on flame throwers and on submarine periscopes. The flame thrower was desired to throw a stream of liquid as far as possible. In order to get the right design of nozzle Mr. Edison instructed one of his helpers to build in his shop a whole series of nozzles with every gradation of angle, length and shape within wide limits, and to pick out the one which threw the stream the farthest.

In the case of the submarine periscope the problem was to prevent the deposit from evaporated salt water spray from rendering the periscope mirror non-reflecting. To prevent this several things were tried, one being to bathe the mirror periodically with materials of very low surface tension, which would prevent the accumulation of water in drops. For this purpose a whole series of liquids was tried and the most satisfactory one selected.

These last two war problems illustrate the method of continual search and trial which underlay much of Edison's work. Notable examples are found in his selection of elements for the Edison storage battery and in his preparation of more than 10,000 double chemical salts in the endeavor to find the most satisfactory fluorescent screen for use with x-rays.

It is a mistake, however, to think that all Edison's work was carried on by this search and trial method. Back of everything which he did or tried there was always an idea. The starting point was always the need of accomplishing some purpose, the second stage seemed to be the suggestion of various ways of accomplishing that purpose, and the final stage consisted in trying out these suggested solutions in as thorough and systematic a manner as possible in order to find the best.

Edison's success lay, I believe, equally in his handling of all three of these stages. He was uncommonly alert to opportunities for supplying a need or presenting an improvement. He was uncommonly ingenious in figuring out ways of designing apparatus to do what he wanted it to do, and he was one of the most patient and persevering men who ever lived in carrying through his ideas to the last stage of comprehensive test.

There are some who think that the day of the inventor of Mr. Edison's type has passed because of the continually greater and greater degree of specialization and scientific background which is demanded. Whether or not this is true, it is certainly true that the talents which Mr. Edison possessed are talents which will always find their outlet in creative service.

Quoting from the inscription under an Edison portrait that appeared in the *General Electric Review*:

He had the boyish fancy to create,
Invent, devise, design, and fabricate.
Sanguine and ardent, bold and fertile too,
He dreamt. Then worked—and made his dreams come true.

J. R. H.

OBITUARY

SAMUEL MATHER

SAMUEL MATHER died in Cleveland, on October 18, 1931, at the age of eighty years. Through this long span of life, Mr. Mather had devoted a large part of his energies and of his fortune to bettering the condition of mankind. In this he blended warm-hearted

sympathy with sound judgment and clear vision. His innumerable benefactions extended to many humanitarian enterprises over the face of the globe. He gave freely to relieve immediate needs, but his wise understanding inclined him particularly toward the fundamental things that make for lasting results. His long service as trustee of Western Reserve University and of the Lakeside Hospital gave him the opportunity of personal insight into the benefits that mankind derives spiritually from higher education, and physically from medical science. These occupied an ever-enlarging place in his interest and to them he gave buildings, endowments and annual subscriptions with great liberality, without diminishing his helpfulness to other humanitarian activities.

As vice-president of the trustees of the university, president of the board of trustees of Lakeside Hospital and chairman of the board of trustees of the University Hospitals, he came to appreciate the benefits of the intimate cooperation of these institutions. He was a prime mover for securing the site of a medical center in the heart of the university; his personal munificence supplied the funds for the new Medical School Building; his influence determined the university policy of the Lakeside, Babies and Maternity Hospitals, and promoted their federation, together with the Rainbow Hospital, into the "University Hospitals"; his example inspired the public to the subscription of funds for the construction of the hospitals on the university site; his wise counsel guided their policy of harmonious cooperation to the day of his death. The weight of his influence was always on the side of humanity and enlightenment, and his judgment was confirmed by the results. Notwithstanding his modest, rather shy self-effacement, his power in the community of Cleveland was supreme; for he led by force of a generous example that lighted a kindred enthusiasm in others. He did not choose to guard his gifts by conditions; he investigated and gave, and the conditions took care of themselves. He trusted people, and they responded to his trust. The generous civic spirit of which Cleveland is proud is the spirit of Samuel Mather.

TORALD SOLLMANN

MEMORIALS

THE Pan-Pacific Research Institution has passed the following minute in memory of Dr. David Starr Jordan:

It is with deepest sorrow that we, the members of the Pan-Pacific Research Institution, learn of the death at Palo Alto, on September 19, 1931, of our beloved friend and coworker, David Starr Jordan, ex-president and chancellor-emeritus of Stanford University.

Dr. Jordan was one of the founders of the Pan-Pacific Research Institution, and its first president as well as the most earnest supporter of its aims and ideals. He, with the members of the Pan-Pacific Science Council, in 1925 drew up the outline of purpose of the institution and aided greatly in getting the work well under way. He believed that here in the mid-Pacific might be developed a great democracy of scientists whose influence in every field of human welfare, including both science and statecraft, as they affected not only the Pacific, but world relations, could be founded. Many of the notable inter-Pacific, if not international, conferences that have been held in Hawaii in recent years are the outgrowth of Dr. Jordan's genius and vision, by which he inspired others to take hold where he left off.

While honorable chairman of the Pan-Pacific Research Institution to the time of his death, he assumed active chairmanship of the Council on Aquatic Resources when he gave invaluable service to the Council and its workers during the Pan-Pacific Fisheries Conference, the beneficial results of which compass the whole Pacific Region.

In the death of David Starr Jordan our institution, as well as the entire American Commonwealth, sustains one of its greatest losses. Dr. Jordan was one of the foremost educators and scientists, as well as publicists, that America has claimed in the past generation. A leader who mingled with all the people and gave the best he had to give for more than half a century.

THEO. C. ZSCHOKKE,
E. H. BRYAN, JR.,
F. G. KRAUSS

IN honor of the late Dr. Stephen M. Babcock, hollyhock gardens will be planted in at least forty-four different states on the grounds of the colleges of agriculture and agricultural experiment stations. The seed for these gardens was gathered this fall from Dr. Babcock's garden. Officials of the University of Göttingen, where Dr. Babcock completed his training, are planting a Babcock garden in his memory, as are the directors of Tufts College at which he spent his undergraduate days.

A PORTRAIT of the late Dr. Hiram Woods, Baltimore, was presented to the Medical and Chirurgical Faculty of Maryland, where he was for many years professor of diseases of the eye and ear, on November 17, at a meeting of the Osler Historical Society. Dr. Lewellys F. Barker made the presentation, and Dr. James M. H. Rowland, president, accepted the portrait on behalf of the medical faculty. Dr. Henry E. Sigerist, professor of the history of medicine, University of Leipzig, gave an address.

A MARBLE bust of the late Dr. Giovanni Di Cristina, professor of children's diseases at Palermo, who died in 1928, has been unveiled in the grounds of the Palermo Children's Hospital.

Nature reports that a tablet has been placed on the house in Egerton Road, Bristol, where he lived for the last twenty-six years of his life, in memory of the late Mr. W. F. Denning, the veteran amateur astronomer

and observer of meteors, who died on June 9. The tablet was unveiled on Dec. 18 by Dr. H. Knox-Shaw, president of the Royal Astronomical Society, in the presence of a number of Mr. Denning's relatives and friends.

IT is reported in the *Journal* of the American Medical Association that a committee has been formed that counts among its honorary members eminent anatomists and embryologists of all lands, while the executive committee is composed of Belgian scientists, presided over by Professor Leon Crisner. The committee was appointed to honor the memory of Albert Brachet, director of the Institute of Anatomy and Embryology at Brussels. It plans to establish an Albert Brachet prize to be awarded by the Academy of Sciences of Belgium, with which to reward the best research done in the domain of embryology.

RECENT DEATHS

DR. JOHAN AUGUST UDDEN, director of the University of Texas Bureau of Economic Geology, died at his home in Austin, Texas, on January 5, aged seventy-three years. He was born in Sweden and migrating to Minnesota received his A.B. degree from Augustana College, Rock Island, Illinois, where he was professor from 1888 to 1911. He became interested in geology through the memorable work of Meek and Worthen being done at that time on the Illinois Geological Survey. He went to Texas in 1911 and has been largely instrumental in the development of the mineral wealth of the state. For his discoveries linking together systematic geology and mining he was knighted by the King of Sweden in 1911. It was on Dr. Udden's advice that the drilling which resulted in the oil fields of west Texas was begun. He also incited the exploration of the Permian of western Texas for potash. Dr. Udden has been active in scientific work throughout the country.

DR. BURTON ALEXANDER RANDALL, professor emeritus of otology at the University of Pennsylvania, died on January 4, at the age of seventy-three years.

DR. HENRY L. FRIEDBURG, professor emeritus of chemistry at the College of the City of New York and lecturer at Hunter College, died on December 29. He was eighty-six years old.

DR. WILLIAM BRIAN DUNCAN, assistant professor of electrical engineering at Stanford University, died on December 18 at the age of thirty-three years.

THE death at the age of sixty-four years is announced of Dr. J. P. Lotsy, of Leiden, secretary of the International Association of Botanists.

SCIENTIFIC EVENTS

ITALIAN PROFESSORS AND THE FASCIST GOVERNMENT

A GROUP of leading Harvard professors, headed by Dr. Roscoe Pound, dean of the Harvard Law School, has requested the Institute of Intellectual Cooperation of the League of Nations to consider ways and means by which Italian university professors may escape the obligation to take the oath of allegiance to the Fascist régime. The letter reads:

We, professors and members of the various faculties of Harvard University in Cambridge, Massachusetts, United States of America, take the liberty of bringing to the attention of the Institute of Intellectual Cooperation the Royal Decree of the Italian Government of August 28, 1931, No. 1227.

This decree imposes upon all university professors of the Kingdom of Italy—and among all state officials of the Department of Education it is applicable to university professors alone—the obligation to take an oath which implies complete adherence without reservation or discussion to a particular system of political ideas.

Since political doctrines no less than all others should be the subject of discussion and revision, it seems to us that this oath involves an intellectual coercion which is incompatible with the ideals of scholars. As such, we feel that the Institute of Intellectual Cooperation among Nations can not ignore it. In no other way can the peoples of the world better promote intellectual cooperation than by extending mutual assistance to each other to secure to all scholars those conditions of freedom under which disinterested search for truth alone becomes possible.

We, therefore, request the Institute of Intellectual Cooperation to consider ways and means by which the Italian university professors may best be helped to defend their intellectual liberty.

The oath required of the Italian professors is as follows:

I swear to be faithful to the King and his royal successors and to the Fascist régime, to observe loyally the statute and other laws of the state; to exercise the teaching function and to fulfill all academic duties with the purpose of forming citizens active, bold and devoted to the fatherland and to the Fascist régime. I swear that I do not belong and will never belong to any association or party the activities of which are not in harmony with the duties of my office.

Eleven professors have refused to take this oath and have lost their university chairs.

MINERAL RESEARCH PROGRAM OF THE ILLINOIS GEOLOGICAL SURVEY

A NEW mineral research program has been inaugurated by the Illinois State Geological Survey, located on the campus of the University of Illinois, at Urbana.

Hitherto, the organization has concerned itself primarily with the study of the raw materials and rock substances of the state. This class of work will be continued, but the new program proposes to take advantage of the information already gathered (and that which later surveys will reveal), and extend the scope of research to cover utilization and marketing as well.

The new program proposes:

(1) To secure and make available both scientific and economic data which will nourish and promote the state's mineral industries;
(2) To investigate thoroughly the constitution and properties of all Illinois rock and mineral substances, paving the way for maximum utilization, either by improvement of present uses or discovery of new uses, or both;
(3) To bring the fundamental information to such a point that it can be used directly by industries and private individuals to exploit deposits to the fullest and most profitable extent;
(4) To make known the production and flow of minerals into and out of Illinois, the marketing opportunities, existing obstacles or limitations, and trends in the various industries.

New laboratories for the researches, with the most up-to-date equipment obtainable, were recently dedicated, the ceremonies being attended by leading mineral producers, manufacturers, business leaders, geologists and representatives of universities and scientific societies of Illinois and the middle west.

Dr. M. M. Leighton, chief of the Geological Survey, has made a number of recent staff appointments, to supplement the work of his regular geologic staff. The additions to the personnel are as follows:

Enid Townley, M.S., associate geologist and assistant to the chief
Judson R. Griffin, Ph.D., assistant geologist
Ralph E. Grim, Ph.D., petrographer
Robert J. Piersol, Ph.D., physicist
Frank H. Reed, Ph.D., chief chemist
Gilbert Thiessen, Ph.D., associate chemist
Charles F. Fryling, Ph.D., chemist
Orin W. Rees, Ph.D., associate chemist
Wm. D. Allers, B.S., chemistry assistant
John Robinson, B.S., chemistry assistant
L. D. McVicker, chemistry assistant
Carl Westerburg, chemistry assistant
Walter H. Voskuil, Ph.D., mineral economist

THE JOURNAL OF CELLULAR AND COMPARATIVE PHYSIOLOGY

At a meeting of the Advisory Board of the Wistar Institute, held on May 19, 1931, a resolution was passed requesting that a meeting of representatives of each journal published by the Wistar Institute be held for the purpose of considering methods by which the material offered for publication in the several Wistar Institute journals might be best accommodated.

Later, on June 14, a conference of editors was held at the Morris Biological Farm of the institute, and steps were taken to suggest certain improvements in the preparation of papers for publication in the institute's journals. At the same time it was suggested that a new physiological journal be established to accommodate physiological papers which now appear in the anatomical or zoological journals.

This meeting was followed on August 12 by a meeting, held at the Marine Biological Laboratory at Woods Hole, of physiologists and others interested in the proposed new journal of physiology, and a group of physiologists was selected to organize the proposed journal, select a managing editor, and add to its number if it seemed desirable.

On October 17 and 18 the physiologists met at the Morris Biological Farm and decided upon the policy of the journal, selected a managing editor, and added to their number certain other physiologists, representing other phases of the science or other geographical regions. Dr. E. Newton Harvey, of Princeton University, was chosen managing editor. The other members of the board of editors are: W. R. Amberson, University of Tennessee; D. W. Bronk, University of Pennsylvania; M. H. Jacobs, University of Pennsylvania; R. S. Lillie, University of Chicago; E. K. Marshall, Jr., the Johns Hopkins University; G. H. Parker, Harvard University; A. C. Redfield, Harvard University; H. W. Smith, New York University, and L. Irving, University of Toronto.

The announcement of the *Journal* reads as follows:

Owing to the increasing number of papers in the field of general and comparative physiology now published in journals not primarily devoted to this subject, it has appeared desirable to bring the material together in one publication. The proposed *Journal of Cellular and Comparative Physiology* is intended as a medium for the publication of papers which embody the results of original research of a quantitive or analytical nature in these fields, including both their physical and chemical aspects. Short preliminary notices are not desired and papers will not be accepted for simultaneous publication or which have been previously published elsewhere. While not specifically excluding any particular branch of physiology, contributors should recognize that excellent journals already exist for publication in the field of experimental and physiological zoology, dealing particularly with genetics, behavior, developmental mechanics, sex determination, and hormonal interrelationships, and also for pure mammalian functional physiology and the physical chemistry of non-living systems. Preference will be given to analyses of fundamental physiological phenomena whether the material is vertebrate or invertebrate, plant or animal.

It is recognized that prompt publication is essential, and the aim will be to issue papers within two months

of acceptance. An abstract not exceeding 225 words must accompany each manuscript. These abstracts will be published immediately in the Wistar Institute Advance Abstract Sheets and appear later on the Wistar Institute Bibliographic Service Cards. Manuscripts should conform to the Wistar Institute publication standard. They should be sent to the managing editor or any associate editor. One hundred reprints of each article are furnished to the author or authors free; additional copies may be obtained according to rates which will be quoted as soon as the manuscript has been examined.

This journal will be issued on the twentieth days of February, April, June, August, October and December. A volume will contain approximately 500 pages and may be closed with any issue. The journal will be sold by the volume, not by the year.

THE NON-RESIDENT LECTURER IN CHEMISTRY AT CORNELL UNIVERSITY

THE non-resident lecturer in chemistry at Cornell University for the second term of the present academic year, February 15–June 1, will be Professor Alfred E. Stock, director of the Chemical Institute of the Technische Hochschule of Karlsruhe, Germany.

Professor Stock was born in Danzig in 1876, and received the degree of doctor of philosophy, *Magna cum Laude* from the University of Berlin in 1899. In 1898 he held the position of lecture assistant under Professor Emil Fischer at the University of Berlin, and from 1899 to 1900 he carried on investigations in the laboratory of Henri Moissan in Paris. Returning to Berlin he qualified for the position of privat-docent in 1904 and was promoted to a professorship in 1906. In 1909 he went to Breslau as professor of inorganic chemistry in the newly founded Technische Hochschule there, and was appointed director of the Institute of Inorganic Chemistry. In 1925 he was called to the University of Münster, but before entering upon the duties of that position he accepted appointment in the Kaiser Wilhelm Institute for Chemistry in Berlin-Dahlem, and became director of this institute and professor in the philosophical faculty of the University of Berlin in 1921. He resigned this position in 1926 to accept appointment as director of the Chemical Institute of the Technische Hochschule of Karlsruhe.

Professor Stock, according to our correspondent, "is one of the most versatile and gifted investigators in the field of inorganic chemistry, and his many investigations, numbering over 160, are characterized by brilliant experimental technique and convincing thoroughness." While at Cornell he will lecture upon the high-vacuum method for studying volatile substances, the chemistry of boron, the preparation and properties of beryllium, and chronic mercurial poisoning, discussing in detail the detection and determination of traces of mercury. His introductory public lecture, to be delivered on February 17 will be on "The Present State of the Natural Sciences." His regular lectures will begin on Thursday, February 18.

SCIENTIFIC NOTES AND NEWS

THE gold medal of the Royal Astronomical Society has been awarded to Dr. Robert Grant Aitken, director of the Lick Observatory, for his work on double stars.

AT a testimonial dinner given recently by the Medical Society of the City and County of Denver, a portrait of Dr. Henry Sewall, emeritus professor of medicine at the University of Colorado School of Medicine, was unveiled and formally presented to the society by Dr. Harry J. Corper. Dr. Frank W. Kenney, secretary of the board of trustees of the society, made the speech of acceptance. Dr. James R. Arneill was toastmaster.

DR. CHARLES V. CHAPIN, superintendent of health of Providence since 1884, retired from active service on January 4. The Providence Medical Association has adopted a resolution in which tribute is paid to Dr. Chapin's long and distinguished service.

THE annual meeting of the New York Academy of Medicine on January 7 was preceded by a testimonial dinner given in honor of Dr. Linsly R. Williams, director of the academy. Among those elected to fellowships in the academy were Drs. Karl Landsteiner, Phoebus A. Levene and Peter K. Olitsky, of the Rockefeller Institute, and to associate fellowships, Dr. Stanley R. Benedict, of the Cornell Medical School, and Drs. John H. Northrop, W. J. V. Osterhout and Donald D. Van Slyke, of the Rockefeller Institute.

DR. LIGHTNER WITMER, professor of psychology at the University of Pennsylvania and director of the Psychological Clinic, was the recipient of a volume entitled "Clinical Psychology—Studies in Honor of Lightner Witmer—Commemorating the Thirty-Fifth Anniversary of the Founding of First Psychological Clinic," at a special meeting on December 11 of the faculty of the college. Dr. Paul H. Musser, dean of the faculty, called upon Dr. Robert A. Brotemarkle, editor of the volume, who read the dedication page. Dr. Edwin B. Twitmyer, professor of psychology, assistant director of the clinic and chairman of the department, extended congratulations to Dr. Witmer. Dr. Josiah H. Penniman, provost in charge of re-

search, made the commemorative address on "The Man and His Work." President Thomas S. Gates then presented the volume to Dr. Witmer.

A TESTIMONIAL dinner in honor of the seventieth birthday of Dr. Max Einhorn, known for his work in gastro-enterology, was given by the staffs of the Lenox Hill Hospital, the Post-Graduate Hospital and the members of the German Medical Society and the International Medical Club of America, at the Hotel Astor, New York City, on January 9.

DR. ELLEN CHURCHILL SEMPLE, professor of anthropogeography at Clark University from 1921 to 1928, who was awarded the Cullom gold medal of the American Geographical Society in 1913 for her work on the effect of geographical conditions upon the development of society, has presented the medal with her library to the University of Kentucky.

DR. LOUIS B. WILSON, director of the Mayo Foundation for Medical Education and Research, University of Minnesota, Rochester, was recently elected president of the Association of American Medical Colleges. At New Orleans Dr. Wilson was elected president for two years of the Society of the Sigma Xi.

AT the annual meeting of the American Anthropological Association at Andover, Massachusetts, on December 29, the following officers were elected for the year 1932: *President,* John R. Swanton; *First Vice-president,* Warren K. Moorehead; *Second Vice-president,* Wilson D. Wallis; *Secretary,* John M. Cooper; *Treasurer,* Edward W. Gifford; *Editor,* Robert H. Lowie; *Associate Editors,* Edward W. Gifford, Frank G. Speck and Frank H. H. Roberts, Jr.; *Executive Committee,* A. Irving Hallowell, H. Newell Wardle and M. W. Stirling.

DR. J. G. FITZGERALD has been appointed dean of the faculty of medicine of the University of Toronto, to succeed Dr. Alexander Primrose. Dr. E. Stanley Ryerson, professor of surgery, has become assistant dean.

DR. JAMES D. BRUCE, director of the department of post-graduate medicine at the University of Michigan, has been appointed vice-president of the university in charge of university relations.

PROFESSOR OTTO V. ADAMS, member of the civil engineering faculty, has been appointed acting dean of the engineering school of Texas Technological College. He succeeds Dean Wm. J. Miller, who has accepted a position as head of the department of electrical engineering in the University of North Carolina. Professor C. V. Bullen, of the University of Oklahoma, has been appointed head of the electrical engineering department of Texas Technological College, a position also held by Dean Miller.

THE Lukens Steel Company of Coatesville, Pennsylvania, has established at the Mellon Institute, Pittsburgh, Pennsylvania, an industrial fellowship whose purpose is the scientific investigation of processes employed in the manufacture of steel plates. Dr. Erle G. Hill, who received his professional education at the University of California, has been appointed to this fellowship. He is a specialist in iron and steel technology and was previously associate professor of metallurgy in the School of Mines of the University of Pittsburgh.

DR. A. J. KLUYVER, professor of microbiology at the Technical University of Delft, Holland, will be visiting professor at the Iowa State College from May 1 until the latter part of July, lecturing on physiology and biochemistry of bacteria.

DR. RICHARD HARDIE, professor of botany at the University at Stuttgart, has been called to Göttingen.

DR. CHARLES SINGER has become professor of the history of medicine in the University College, London, and Mr. E. F. D. Witchell, professor of mechanical engineering in the Imperial College, City and Guilds College.

SIR RICHARD GREGORY, editor of *Nature,* gave a popular lecture on January 6 on "Comets and Shooting Stars" before the twentieth annual conference of British Educational Associations held at University College, London.

DR. ERNST WALDSCHMIDT-LEITZ, of the University of Prague, will give in April the Dohme Lectures at the Johns Hopkins University.

DR. WILLEM DE SITTER, director of the Astronomical Observatory of the University of Leiden, Holland, who was invited by the University of California last September to visit the United States, has been making a lecture tour of the country which will culminate with two series of lectures to be delivered at the university, beginning on January 18. Professor de Sitter will be the first lecturer on the Charles M. and Maria Hitchcock Foundation for the year 1932. His first series, consisting of three addresses, will deal with "The Astronomical Aspects of the Theory of Relativity." His second series of three lectures, during the week of January 25, will deal with "The System of Astronomical Constants."

THE meeting of the Washington Academy of Sciences on January 12 was a joint meeting with the Geological Society of Washington. Dr. F. A. Vening Meinesz, professor of geodesy at the University of Utrecht and a member of the Netherlands Geodetic Commission, delivered an illustrated address on "Gravity Results of Submarine Expeditions in the East and West Indies and their Relation to Tectonic Phenomena."

DR. WILLIAM H. WELCH, professor of the history of medicine at the Johns Hopkins University, gave a Mayo Foundation lecture at Rochester, Minnesota, on January 1 on "English Surgical Reformers of the Sixteenth Century."

DR. LEWELLYS F. BARKER, professor emeritus of medicine at the Johns Hopkins University School of Medicine, is giving the annual Scripps Metabolic Clinic lectures for the members of the San Diego County Medical Society on January 9, the subject being "Obesity." Dr. Barker gave a series of bedside clinics from January 7 to 9. The Scripps Clinic Lectureship Endowment makes it possible to bring a lecturer to southern California each year.

DR. S. J. CROWE, of Baltimore, will deliver the fourth Harvey Society Lecture at the New York Academy of Medicine on Thursday, January 21. His subject will be "Investigations on the Underlying Causes of Deafness."

PROFESSOR EMIL TRUOG, of the University of Wisconsin, will give a series of six daily lectures on soils, plant nutrition and fertilizers at the Massachusetts State College during the week of February 14 to 20.

DR. H. D. ARNOLD, director of research at the Bell Telephone Laboratories, New York City, delivered on the evening of January 6 at the Lowell Institute the first of seven lectures on "The Application of Science in Electrical Communication" to be given by representatives of the Bell Telephone Company. The lectures, covering various branches of electric communication, take place on successive Tuesday and Friday evenings.

THE Stanford University School of Medicine has announced a special course of popular medical lectures to celebrate the fiftieth anniversary of the lectures founded in 1881 by Dr. Levi Cooper Lane. They are given in Lane Hall on alternate Friday evenings at eight o'clock. The lectures are: January 8, "Dr. Levi Cooper Lane and the Popular Medical Lectures," Dr. Emmet Rixford, San Francisco; January 22, "Half-century of Progress in the Recognition and Treatment of Disease," Dr. George Dock, Pasadena; February 5, "Achievements in Surgery of the Past Fifty Years," Dr. Andrew Stewart Lobingier, Los Angeles; February 19, "Contribution of Experimental Biology and Medicine to the Alleviation of Human Suffering," Dr. Herbert McLean Evans, Berkeley; March 4, "Social Aspects of Child Welfare," Dr. Henry Dwight Chapin, New York City; March 18, "Fifty Years of Progress in the Prevention of Disease," Dr. Jacob Casson Geiger, San Francisco.

THE Western Society of Naturalists held its fourth winter meeting at the University of California on December 21 and 22, with some fifty members and guests in attendance and twenty-four papers on the program.

THE annual meeting of the American Heart Association will be held on Monday, February 1, at 4:30 P. M., at the offices of the association, in the Nelson Tower, 450 Seventh Avenue, New York City.

THE International Congress of Mathematicians will meet at Zurich, Switzerland, from September 4 to 12. There will be a formal reception on the evening of September 4, and the inaugural meeting will take place on the morning of September 5. Morning sessions will be devoted to general addresses and afternoons to meetings of the sections. In the evenings there will be receptions and a concert. The congress will be followed by an excursion to the Jungfraujoch. Those from the United States and Canada expecting to attend are requested to write to Professor F. Gonseth, Ecole Polytechnique Fédérale, Zurich, Switzerland.

THE thirty-fourth annual meeting of the Maryland State Horticultural Society was held at the new horticultural building of the University of Maryland, College Park, on January 4 and at the Lord Baltimore Hotel on the following day in connection with the convention of the Maryland Farm Bureau Federation. In addition to speakers who discussed problems of fruit growing, a feature of the program was the inspection and dedication of the new horticultural building at College Park. State Senator Earle W. Withgott, Easton, vice-president of the Horticultural Society, presided at the dedication and Mr. Samuel M. Shoemaker, chairman of the university board of regents, made the principal address. The horticultural building measures 186 by 98 feet and is of concrete and stone construction. The main section is of three stories, flanked by two wings of two stories. The building contains laboratories for all types of horticultural plant research, canning, fruit packing, spray machinery and spray practice. Space has been provided for later installation of controlled cold rooms, where effects of low temperature upon fruits and all types of plants can be studied. Classrooms, offices, a horticultural library, an assembly room and the laboratories of floriculture, nursery and ornamental horticulture occupy the upper floors of the building.

A NEW teaching museum has been opened at Rutgers University by the department of zoology of the New Jersey College for Women, a unit of the university. It occupies the Yardley Memorial Room in the zoology building, named in honor of Mrs. Margaret Tufts Yardley, first president of the New Jersey State Federation of Women's Clubs, under whose direction

the money for the building was raised and given to the college. The museum is open to the public and contains about half the teaching exhibits of the department of zoology, including 225 mounted birds (New Jersey), 90 bird skins (native and exotic), skeletons of vertebrates, preserved materials, anatomical models and common invertebrates and smaller vertebrates of the state.

DISCUSSION

A POSSIBLE MEANS OF CUTTING DOWN THE MOSQUITO POPULATION

LAST July, while operating a large electric resistance heater enclosed in the fire-brick structure used for spraying quartz to form a mirror blank, Mr. A. L. Ellis called my attention to the circumstance of myriads of what seemed to be mosquitoes dead and resting on the broad domed top surface and in crevices in the top of the furnace. This demanded an explanation, and the following is taken from a memorandum that was made:

> Mr. Ellis has called my attention to the fact that during the operation of the furnace in spraying the 60-inch quartz disk recently, great numbers of what appeared to be mosquitoes have fallen on the top of the dome which covers the furnace in which the spraying is going on. The total number of these insects which have met their deaths above this furnace seems to be many thousands; undoubtedly a great lot of them have been blown away. On collecting some of the corpses which are abundant on top of the furnace, especially in the cracks, I have tried to determine the sex of these insects, whether they are females or males. This raises another question. If the insects found are males, why do they appear at the furnace in such large numbers? There is a possible answer which may or may not be true. The electric devices near the furnace produce a fairly strong three-phase 60 cycle hum, pervading all the space around it. Can it be possible that this hum represents the hum of the female mosquito and serves an an attraction for the males which gather where the noise is prevalent? If this were the case, then we should be able to account for the vast numbers of these creatures which have come to their deaths in approaching the furnace, and furthermore, and more important, there may be pointed out some way of getting rid, to a large extent, of the mosquito population. Certainly, if the male can be drawn to a spot and cooked, then the egg-laying power of the female would be curtailed, and we shall have a great diminution in the mosquito population, provided the above reasoning is in accordance with fact and provided devices are developed to produce a three-phase 60 cycle hum where mosquitoes are bred and spread about, with means for destroying the mosquitoes which are so attracted. They may be burned, or drowned, or shocked, or cooked.
>
> ELIHU THOMSON
>
> (July 14, 1931.)

The mosquito season passed, and there are now no such insects for further experiments. Let me add that where the event in which the foregoing was based took place was at the River Works (Saugus River) of the General Electric Company at Lynn, Massachusetts. Southwest of the works is an extended area of marsh land, much of it covered with pools, either due to rains, or to overflow at high tides from the sea.

Recently, in telling of the above suppositions of mine to Professor George H. Parker, of Harvard University (Department of Zoology), he kindly confirmed my guesses by saying that only the female mosquito sings or produces its characteristic note when flying, and that the males are provided with bushy antennae projecting from the head on each side, and that these are the organs of hearing, whereby the male recognizes the presence of the female somewhere near.

Now, the three-phase 60 cycle hum of the heaters in the furnace—a sort of third harmonic to the 60 cycle rate—is to my ear an exact representation of the noise one hears as a female mosquito visits one in the night, and one endeavors to crush the annoying creature by a slap of the hand on the side of the face where the pest appears to be ready to draw blood from the victim of its attentions. The fact that the note from the furnace is individual (a single note) and that its reach must be great on account of the size of the furnace itself, the object from which it emanates, would account for the multitude of males which flew towards it from the marsh land during the period of operation of the furnace.

The insects evidently hovered for some time over the warm roof of the furnace itself, and were thus gradually desiccated and fell thereon.

Can the whole race of them be thus decimated or extinguished by proper utilization of these principles?

It is notable that, in spite of the great swarm of insects, there were no reports of bites from the men employed in the furnace house. The males do not bite. The females do so, in attempting to secure nutrition for the nourishment and development of the eggs which they proceed to lay in the stagnant pools. It is easy to organize an electro-magnetic "hummer" which, at small expense of energy, can spread over a large space the peculiar hum, and attract the males; perhaps also repelling the females. Various ways of trapping the males may be suggested, as they need not be desiccated or cooked to get rid of them.

It should be added that I was informed by Dr. Parker that some efforts at attraction of male mos-

quitoes by producing a musical note as near as possible to that given out by the female insect itself as a lure to a trap had been made, as he remembered, but I have no further knowledge of this effort as to its effectiveness.

ELIHU THOMSON
GENERAL ELECTRIC COMPANY,
LYNN, MASSACHUSETTS

THE NEED FOR A NEW EXPERIMENTAL APPROACH IN IMMUNOLOGY

THIS is an age of skepticism in immunology. By degrees the top-heavy superstructure of immunological truths (?) has been crumbling under the attack of the more liberal-minded workers, who are seeking to rationalize the cult of immunology in the light of chemical investigation. With the knowledge gained in the study of the protein molecule, its antigenic properties, its property of altered specificity and the part that haptenes play in altering this specificity, as well as the possibility of synthesizing antigens that will react specifically with antisera prepared from "natural" antigens; these and other trends in the more recent investigations in this field spell the doom of the older ideas, and lead the way for the final abandonment of the ornate concepts and terms that have dominated the subject and throttled any rationalistic advance up to this time.

No better evidence need be adduced to show the error of the older concepts of this branch of science than the repeated clinical failures with therapeutic agents prepared according to the established immunological theories. Even the long-suffering clinicians have ceased to clutch at the therapeutic straws that the immunologists have from time to time cast forth on the sea of hypothesis and look askance instead at any new therapeutic agent with an immunological background. In this they have recently been joined by the literary fathers of the profession,[1] so that at present the general question is "what is wrong with immunology?"

To one who is not an immunologist, a relatively simple answer offers itself at once. It may be briefly expressed by the single word—overspecialization. From a subject that originally centered about disease processes in animals or plants it has gradually developed until now it largely ceases to consider the disease and concerns itself instead with a very intensive investigation of the disease-producing agent and its various manifestations. Thus it has ceased to be the fashion to study the disease in its entirety and to substitute instead a finer and apparently more fruitless study of the alleged agent of causation of the disease. The immensity of this potential error is appalling. What if these diseases that in the main show such clear-cut clinical manifestations as to enable the clinician to constantly classify them, should be caused by agents other than those that are now credited to them! Think of the wasted immunological endeavor of recent years, if time shows that scarlet fever as it is clinically manifest, is due not to a single strain of streptococcus, but rather as recent workers are inclined to believe, to any one of a number of strains provided beforehand with a suitable environment and therefore producing a specific type of toxin. Contrast this with the greater progress that might have been made if the investigation of this disease had been conducted along lines controlled by fundamental biological facts, the chief of which being the close interrelationship between disease producing agents and their environment. How uneasy must Sydenham, Jenner, Pasteur and Koch rest when they view our repeated attempts to replace observation and experimentation *in vivo* by methods *in vitro*! One of the greatest assumptions that over-specialization in the field of immunology has sanctioned is that the test-tube is analogous to the living host. This has been a considerable handicap to progress and has led to more wasted effort than any other single factor. Fortunately the view-point is already changing and evidence is rapidly accumulating to show what an important influence the host exerts in the fundamental biological characteristics of the invading organism in cases of infectious disease. Witness the recent work of Veblen[2] who on growing certain organisms like *Streptococcus viridans* and *Bacillus typhosus* for several generations in dilute horse serum is able to demonstrate agglutination of these organisms in high dilution with an anti-horse rabbit precipitin serum, the organisms losing at the same time their ability to agglutinate with specific bacterial agglutinating sera.

In order therefore to depart from the unbiological lines of investigation that this subject has followed in the past, it is suggested that the time seems now ripe to chart and follow another line of research; one that will above all give adequate consideration to the behavior of the host in the process of attack from the invading agent. Promise of success in the light of such an attempt is not lacking. Already there is accumulated evidence to show that the cellular aggregate that goes to make up the organs and tissues of the invaded host has something to contribute toward influencing the biological nature of the invading agent. The recent work of Laidlaw and Dunkin[3]

[1] Editorial in *Journal* of the American Medical Association, Vol. xciii, p. 1890.

[2] Veblen, *Soc. Exp. Bact. and Med.*, 27: 204, 1929.

[3] P. P. Laidlaw and G. W. Dunkin, *J. Comp. Path. and Therap.*, 41: 1, 1928.

suggests that the virus of distemper when "hybridized" with the tissue of the dog (splenic pulp) is a distinct immunological entity from the same virus hybridized with the tissue (splenic pulp) of the ferret.

In this new approach due consideration should be given to the fundamental biological laws. For example no essential difference should be recognized as existing between the rapidly growing invading organism and the equally rapid growth and development of the cells of the host during the height of invasion. Just as the bacterial agents in process of their metabolism produce certain agents injurious for the host, it is likely also that those cells of the host at the site of invasion produce metabolic products that are injurious to itself. If these bacterial products by virtue of their nature as proteins, are able to lead to the production of specific interacting substances demonstrable by certain physico-chemical phenomena, *e.g.*, agglutination and precipitation, then it might be equally true that certain toxic products of the invaded cells of the host, by virtue of their protein nature, or, as likely, by their ability to act as haptenes to the main protein radicle involved in the chemical reaction, would lead also to the production of certain specific substances interacting either with the composite antigen or with the haptene group derived from the host cells.

If this newer conception be correct, then recovery from infectious disease is due to the development of neutralizing substances to the foreign proteins in the tissues and blood of the infected individual which result not only from the invasion and growth of the bacterial invader but also from the cellular destruction in the host. Such foreign proteins from the host being antigenic for the same species is not just a hypothetical possibility, as it has already been demonstrated by Landsteiner[4] to be true in the case of homologous tissue protein (serum albumin) treated with formaldehyde, nitrous oxide and other chemical agents.

Thus it seems altogether desirable that future investigations dealing with the production of therapeutic agents in diseases of bacterial origin, should develop along lines directed at establishing conditions similar to those that govern the interaction between the invading organism and the host, such as for example the production of the essential features of the disease in lower animals, followed by the utilization of such material from the involved tissue as a composite antigen to be used in the production of antisera. It is to be hoped that future experimental evidence will show that such antisera contain readily available neutralizing substances directed at the dual toxemic products of both bacterial and tissue destruction that result in the course of these bacterial infections.

THEODORE J. CURPHEY
HERMAN B. BARUCH
UNIVERSITY AND BELLEVUE HOSPITAL
MEDICAL COLLEGE,
NEW YORK, N. Y.

[4] Landsteiner and Jablous, *Z. Immunitat.*, 20: 618, 1914.

RUMBLING CLOUDS AND LUMINOUS CLOUDS

A BRIEF description of two rather unusual cloud phenomena which have come to my notice may be of some interest. One of these was observed from the east shore of a narrow bay of Cache Lake in Algonquin Park, Ontario, on an early morning during the latter part of July of this year. It was a chilly morning and the sky was completely overcast with clouds. My attention was attracted by a rumbling sound coming from the west, such as heralds the approach of a heavy thunder storm. As I watched, a very long, low, narrow, tenuous cloud, resembling a squall cloud, appeared above the trees on the opposite shore, moving at right angles to its length. The continuous, rumbling noise, now grown remarkably loud, seemed to come unmistakably from this cloud, whose cross-sectional diameter was only about 200 feet. The cloud passed overhead eastward and was not followed by the expected rain storm. The cloud apparently marked the meeting place of two oppositely directed currents of air that differed in temperature. It seems almost incredible, however, that so much sound could have arisen from the agitated air alone, and yet this seems to be the only plausible explanation of its origin. I steadfastly looked for small lightning flashes in the cloud and saw none, although they would have had to come in rapid succession to produce the persistent sound which was heard. The noise could not have come from the rattle of hail because the cross-section of the cloud was too small to give time for hail formation; and in any case no hail fell.

The other cloud I wish to describe was a solitary, brightly luminous, cumulus cloud which I saw on a clear summer night at Hutchinson, Minnesota, some thirty-five years ago. The cloud had a horizontal diameter of about a third of a mile and a thickness of about one fourth of that distance. It rose majestically from the eastern horizon, shone with a uniform, steady, vivid, whitish light and passed directly over the town. When the cloud was overhead a great shower of insects descended to earth covering the ground all around to the number of about 50 to 100 per square foot. These insects proved to be a species of hemiptera and were non-luminous. They had apparently been induced to take wing by the bright object in the sky. I have been at some loss to account

for the luminosity of the cloud. It could not have been due to reflected light coming from a city. It might be postulated that the cloud consisted of a mass of organic vapor that was slowly oxidizing, being in fact a case of an extended will-o'-the-wisp, but for several reasons this seems to be an unlikely hypothesis. At the time the cloud was observed, it was thought to be far too late in the evening for its light to be reflected sunlight. There is a possibility that a bright moon below the horizon might have been the source of the light, although I have no recollection of having seen the moon rise later.

JOHN ZELENY

SLOANE PHYSICS LABORATORY,
YALE UNIVERSITY

ENTOPTIC COLORS

I WAS extremely interested in reading the description of the phenomenon reported by Mr. Paul E. Klopsteg, which he observed in his neon tube experiments. I have observed for some considerable time what I believe to be the same thing, only obtaining it in a different manner. I am an amateur movie enthusiast, and from time to time in setting up my projector I have had occasion to run it without any film, with the light shining against a white screen and at varying speeds. I have noticed that at a certain speed which is somewhat less than the standard speed of 16 per second there is a very decided color phenomenon present. This effect is very difficult to describe, as it appears to be a mixture of flashes of the various colors mentioned by Mr. Klopsteg. I should say also that the frequency would probably be about 10 or 12 per second.

The first time the phenomenon was observed I was undecided as to whether there was a defect in my visual apparatus, but inasmuch as it can be produced at will I came to the conclusion that it was perfectly normal. If, as Mr. Klopsteg suggests, this phenomenon offers an opportunity for some original work, the thought is suggested to serve that my observation might prove of value, inasmuch as a different method of production is used. The illumination used is the regular incandescent lamp which gives a somewhat whiter light than the ordinary incandescent bulb and has a concentrated filament, but otherwise is quite standard.

ELMER F. WAY

INDUSTRIAL LABORATORIES,
GRAND RAPIDS, MICHIGAN

THE PREVENTION OF CONVULSIONS

IN connection with an item under *Science News* entitled "Sunshine and Cod Liver Oil for the Prevention of Convulsions," which appeared in SCIENCE, March 20, 1931, I wish to draw attention to the fact that in a series of experiments conducted at University College Farm, Dublin, on calcium metabolism in the pig, convulsions appeared in a group confined on a non-vitamin D diet, to a compartment lighted through window glass. Similar groups getting vitamin D did not develop convulsions. The experiments are described in a paper published in the *Journal of the Department of Agriculture,* Dublin, Vol. 30, No. 1, from which the following abstract giving a description of a convulsive fit in the pig is taken:

> A pig suddenly developed a tremor which rapidly intensified, the animal arching its back and progressing backwards until impeded by some obstacle. In some cases the pig squealed as if suffering from intense pain and after a lapse of three to five minutes it fell prostrate to recover gradually in from seven to ten minutes after the onset of the attack.

The group of pigs which developed convulsions exhibited all the symptoms of an intensified form of rickets.

E. J. SHEEHY

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SOCIETIES AND MEETINGS

THE TEXAS ACADEMY OF SCIENCE

THE Texas Academy of Science held its annual meeting on November 27 and 28 at San Antonio, where it was the guest of the city and had its meetings in the Witte Memorial Museum through the kindness of Director Ellen S. Quillen. An extensive and varied program was given, which was divided into papers of like interest rather than into those representing any one of the sections of the academy. The section of the geology and its closely related sciences heard among other papers presented one on the "Silting of Lake Worth," by Dean T. U. Taylor, dean of engineering, University of Texas. Dr. E. H. Sellards, of the Bureau of Economic Geology, University of Texas, gave an account of the Texas earthquake, August 16, 1931. This is the first paper in which this earthquake, which was felt over much of Texas and adjacent states, has been reviewed. William Cunningham, of the department of chemical engineering, University of Texas, gave a full account of the sulphur industry of the Texas coast. This paper was perhaps the most enjoyed of any technical paper given at this meeting. From the standpoint of research into unknown fields the paper by Frederick A. Burt, of the Agricultural

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and Mechanical College of Texas, on the "Formative Processes in Certain Aluminum Bearing Concretions" was noteworthy.

The section of biological sciences introduced some new speakers, who presented papers dealing with the subject of "Teaching of Natural Sciences in the Public Schools." The most unique of these papers was the one by Dr. Don O. Baird, of State Teachers College, Huntsville, Texas, on "Birds that Go to School." Charles H. Gable and Ellen S. Quillen, of San Antonio, the authors of a series of "Nature Readers for Public Schools," presented a very interesting discussion of the "Place of Natures Study in Child Education." Dr. W. R. Horlacher and D. T. Killough discussed what may be done in improving the cotton plant in a paper entitled "Chlorophyll Deficiencies Induced in Cotton (*Gossypium hirsutum*) by Radiations." These and a number of other technical papers along the lines of biology made a full day's program.

After the annual dinner, which took place at the St. Anthony Hotel, the section of anthropological sciences gave their program. J. E. Pearce, head of the department of anthropology of the University of Texas, gave an account of the work done by his department during the past year. He told of the bringing to light or of "Finding a Civilization which Once Existed in East Texas and Hitherto Unsuspected by the Archeologists." He illustrated his talk by a large number of earthenware vessels recovered from village-sites, caches and burial places. This pottery is on a par with anything yet discovered in North America and is found in such numbers as to indicate a large population with fixed dwelling places. Another unique find was a peculiar form of arrow-heads, which are always associated with burials. So far as known, this type of arrow-head has not been observed before in the United States. Judging from the published accounts of similar work this find is the outstanding one for the past ten years. Miss Emma Gutzeit, secretary of the Museum Association of San Antonio, gave an interesting illustrated account of four expeditions sent from the museum into the Big Bend Country in search of specimens and information concerning the aboriginal inhabitants of that part of Texas. The pictures shown of pictographs and petroglyphs gave the audience some idea of the kind of records left by the civilizations which have preceded our own. Colonel M. L. Crimmins, curator of anthropology of the Witte Museum, took up the story of early West Texas and told of the migration of the Aztec people from Casa Grande, a now deserted town seventy miles southwest of El Paso, through a mountainous country of Northern Mexico and ending with the arrival of the Aztec people at the City of Mexico. His story was illustrated by copy of a chart made two centuries ago in Mexico and now preserved in Spain. He stated the Aztec people much resembled the Romans and showed how they had left their imprint on the other primitive people with whom they came in contact.

The final session was held on Saturday morning. The papers given were of a general nature. Miss Kethora Remy, of San Antonio, in a paper entitled "The Mineral Content of Honey" gave a summary of a year's investigation to ascertain if there was a relationship between the amounts of minerals contained in honey and other food value. After these papers the regular business meeting completed the program. The reports of officers and committee men showed a fine growth in membership and that the academy was in good financial condition. Ten fellows and a large number of new members were welcomed into the academy. It was ordered that a year book containing the outstanding papers presented at this meeting be printed as soon as possible and that the mimeographed monthly bulletin be continued. The officers for the ensuing year are:

Dr. H. Y. Benedict, University of Texas, *President.*

F. B. Plummer, University of Texas, *assistant to the president.*

W. E. Carter, A. and M. College, *vice-president, section 1.*

E. N. Jones, Baylor University, *vice-president, section 2.*

J. F. Sinclair, Texas College of Arts and Industries, *vice-president, section 3.*

H. B. Parks, Agricultural Experiment Stations, *secretary-treasurer.*

At the conclusion of the annual meeting the executive committee met and decided to hold the summer meeting at Austin, probably the first week in June. The time and place for the annual meeting for 1932 was not decided upon.

H. B. PARKS, *Secretary*

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE SUSPENDED MIRROR SEISMOGRAPH

DURING the last year of a very interesting and somewhat unusual seismograph was developed and used by two of the graduate students under the writer's supervision. Because of the extreme simplicity and high sensitivity of the apparatus, and in view of the rapidly growing interest in seismology a brief description of the instrument may be of interest.

It consists essentially of a light mirror about 3 mm

in diameter hung by means of two silk fibers in an F frame after the manner of Darwin. The frame is of brass mounted on a cast-iron platform with leveling screws. The mirror hangs in the frame as shown and its motion is traced on a photographic film, which is attached to a rotating drum in the usual manner.

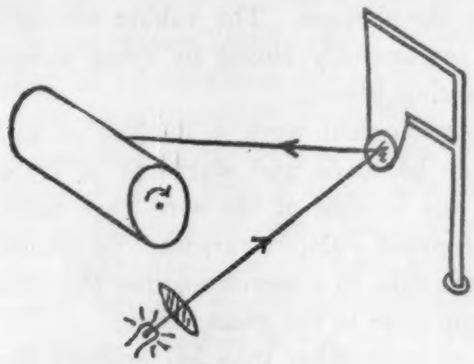

FIG. 1

This drum was made in the laboratory and is driven by a synchronous motor which was bought from one of the numerous radio-wrecking concerns.

The mirror on its support was mounted on a large brick column which was not in contact with the floor of the room. The estimated mass of this column is something like ten tons.

The apparatus has been used thus far in the study of earth tremors and disturbances of a minor nature. It detects with ease the footsteps of a person 100 yards from the building. It records the passing of a street car or an automobile half a mile away and it records (with what a physician says is fair accuracy) the heart beats of a person lying on the heavy column.

Although the apparatus is in a large empty room, remote from the walls, in a large building, it is in continual motion throughout the day. Records made when any part of the building is in use show that the ground under it is in a state of almost steady vibration.

It seems to the writer that this apparatus is particularly well adapted to the study of tremors which do not penetrate the earth very deeply. It is light, simple, inexpensive and easily portable; and it can be set up with a minimum of adjustment.

Results obtained thus far seem to justify the further use of this apparatus in the work for which it was designed.

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APPARATUS FOR TAKING WATER SAMPLES FROM DIFFERENT LEVELS

MANY of the apparatus designed to take water samples from different levels are difficult to manipulate and, in many instances, are not accurate. This is especially true with makeshift apparatus constructed from ordinary laboratory materials. The apparatus described in this paper was used by the author in bacteriological work which required the taking, accurately, of bottom samples. Larger models of the apparatus have since been constructed and used in protozoological work with excellent results. It is easily put together with materials found in every laboratory.

The apparatus as used in bacteriology consists of a glass test-tube with the bottom cut off. This tube is fitted with two rubber stoppers which are drilled to take a piece of glass tubing an inch and a half longer than the rubber stopper. Small wire loops are fastened near each end of the test-tube and are bound in place with thread which is then shellaced or varnished. A piece of short gum rubber tubing about two inches long is slipped over each glass tube which protrudes from the rubber stopper. Other straight pieces of glass tubing with their ends bulged are pushed into

Pl. I.

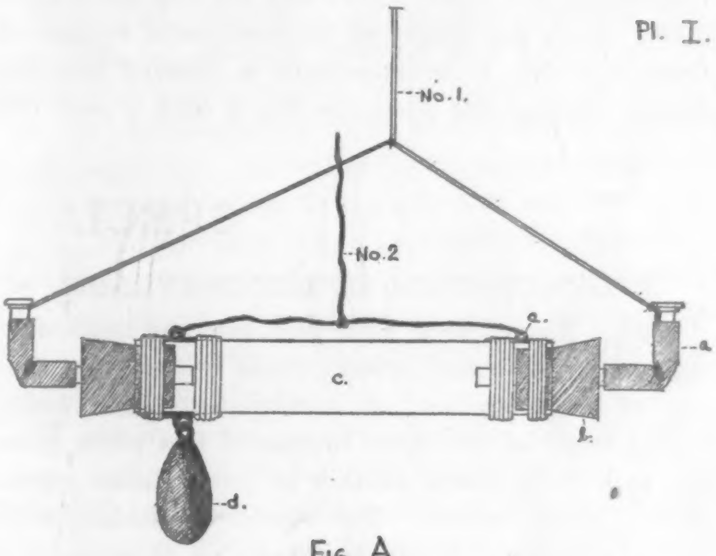
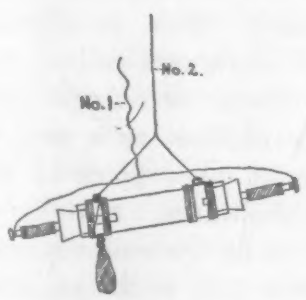


FIG. A.



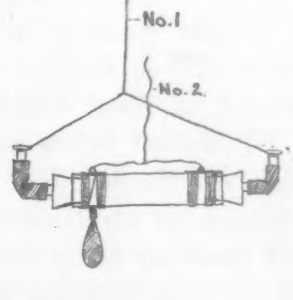


FIG. B. FIG. C

FIG. A. Detail construction: a, rubber connection acting as a valve; b, rubber stopper; c, glass body of instrument; d, lead weight; e, wire loop; No. 1, hand cord for operating the instrument valves; No. 2, hand cord for raising and lowering the apparatus. FIG. B. Apparatus with valves open and weight suspended by cord No. 2. FIG. C. Apparatus with valves closed and weight suspended by cord No. 1.

the rubber tubing, making a simple rubber joint. It is best to daub rubber cement or shellac on the glass tubing before making the connection.

A string is now tied to two of the wire loops, and another string is fastened onto the glass tubes protruding from the rubber joint. Both of these connecting strings are tied so that there is plenty of slack in them. A hand cord is attached somewhere along the length of each connecting string. The two hand cords serve to open and close the valves as well as raise and lower the entire instrument. A lead weight is suspended from the third wire loop which is fixed on the opposite side of the tube from the other loops and at one end. This weight serves to sink the apparatus as well as to slant it so that water can come in the lowest side and force the air from the higher end.

The apparatus is used in the following manner. The weight of the instrument is suspended from hand cord No. 1 (Fig. A) which is attached to the ends of the glass tubing. This action kinks the rubber connections and forms a perfectly air and water-tight valve. With the weight of the instrument supported from cord No. 1 the apparatus is lowered into the water. During this phase the No. 2 cord is paid out very loosely. When the selected depth has been reached the weight is shifted to cord No. 2 and cord No. 1 is loosened. This action allows the rubber connections to straighten out and the valve to open. When the body of the apparatus has been filled the weight is again transferred to cord No. 1, which closes the valves. With the valves closed the instrument is pulled to the surface. The rubber connections may be kept permanently closed by tying strings around the connecting pieces.

In bacteriological work a number of such instruments may be made and sterilized in the autoclave, provided the binding of the wire loops has been fixed with waterproof Valspar varnish. To remove the contents of the tube in a sterile manner the rubber valves may be cut close to the glass tubing.

Types of work other than bacteriology may require apparatus with larger openings. Apparatus have been made at this university with openings up to an inch in diameter with but a few minor changes in the shapes of the glass pieces forming the valves and the use of a double system of rubber connections.

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SPECIAL ARTICLES

REGENERATION IN BRYOPHYLLUM

While *Bryophyllum calycinum* has been repeatedly used in physiological investigations of the phenomenon of "regeneration," a developmental and histological study of the foliar organs of this plant gives rise to a grave doubt whether in this instance regeneration really occurs. The worker is dealing with leaves possessing latent meristems in their notches which quickly form both root and shoot systems when the proper stimulus is applied. Even so able an investigator as Jacques Loeb[1] disregards entirely the presence of these foliar meristems or embryos and L. W. Sharp[2] refers to *Bryophyllum* as a case in which dedifferentiation of cells takes place in the formation of plantlets upon the leaves. A study of these problems being carried on by the writer reveals that too little attention has been paid to the anatomy and developmental history of the leaves of *Bryophyllum* and that physiological studies must take account of these facts if they are to interpret correctly the processes involved in so-called "regeneration."

The question immediately arises as to what the phenomenon of regeneration really involves. Are we to consider as regeneration only such phenomena as the reformation of a tail in the case of certain snakes, the replacement of an eye-like structure in the case of *Cambarus,* or the reformation of a growing point on the shoot axis of a plant? Or shall we include within this category the development of latent buds in the willow, of axillary buds (in many plants) which in the normal course of events never develop, and finally the development of the foliar embryos in the leaves of *Bryophyllum*? All these examples have been lumped together under the term "regeneration" by various workers and since the wide differences existing among them are obvious, the situation is a rather unhappy one.

Particularly is this the case when development of plantlets upon the leaves of *Begonia* is termed "regeneration" and the same term applied to plantlet development upon the leaves of *Bryophyllum*. Hartsema[3] has clearly shown that in the case of *Begonia* there is an actual dedifferentiation of certain cells of the epidermis and an assumption by them of meristematic characters which builds up a new plant. Work of the writer shows that in the case of *Bryophyllum* a group of meristem cells is very early segregated in the notch of the leaf even when it is 2 mm

1 Jacques Loeb, "Regeneration," 1924.

2 L. W. Sharp, "Introduction to Cytology," 1926.

3 A. M. Hartsema, Extrait du Recueil des Travaux botaniques néerlandais, Vol. 23, 1926.

or less in length. These cells retain their meristematic character while the neighboring cells continue in the process of differentiation forming the body of the mature leaf. In actively functioning leaves 8 to 10 centimeters long this group of meristem cells may show a more or less distinct differentiation of root and shoot primordia. The writer has chosen to call these meristematic cell masses "foliar embryos" rather than "foliar buds" or "epiphyllous buds," since root and shoot develop simultaneously from them and may even be present in a primordial condition on a large, normal, attached leaf. Only a slight stimulus of the proper sort is required to cause the foliar embryos to continue their development into a new plant. Under normal cultural conditions such development does not occur on attached leaves yet it would seem that to refer to the roots and shoots produced as "adventitious buds and roots" and to include them under the term "regeneration" would be to employ vague or even incorrect terminology. A careful study of the various phenomena commonly grouped under "regeneration" makes it clear that the task of defining and limiting this term is difficult, but the writer suggests that, in cases where a preformed meristem exists which is definite and localized in position and which merely continues development due to some stimulus, the term "regeneration" is hardly applicable.

The existence of vegetative patches or centers upon the leaves of *Bryophyllum* is by no means a recently discovered fact for Goebel[4] refers to them, and Kerner and Oliver[5] also describe them in a superficial way. Yet few facts seem to exist concerning their structure and developmental history. Lund and Bush[6] diagram a section through the foliar embryo but otherwise make no statements regarding its structure and development except a reference to the work of Beals.[7] To the writer's knowledge this last named work is the only available histological study of the development of the plantlets upon the leaves of *Bryophyllum*. Beals draws the conclusion that certain phloem cells of the leaf assume meristematic activity and build up the tissue of the new plant. No mention was made of the dormant foliar embryo which exists even in very young leaves and which in older leaves is evident to the most casual observer. From Beals' paper it is evident that she was experimenting with fairly mature leaves.

While no attempt has been made in the present study to determine the physiological causal factors involved in the awakening of these foliar embryos it is obvious that such study must take account of their presence and structure. There is no space in the present brief note to give details of the writer's study and findings but it is hoped that they may be published *in extenso* at a later date.

JOHN A. YARBROUGH

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[4] K. Goebel, "Organography of Plants," I, 42, 1900.

[5] Kerner and Oliver, "Natural History of Plants," II, 40, 1903.

[6] Lund and Bush, *Plant Physiology*, 5: 491, October, 1930.

[7] C. M. Beals, *Ann.* Miss. Bot. Garden, 10: 369, 1923.

A NEW PLANT SOURCE OF VITAMIN A ACTIVITY[1]

THE recent interest in carotin and its physiological action has encouraged the examination of various plants as a source of this material. It occurred to the writers that a further investigation of the coloring matter annatto, obtained from the seeds of the plant *Bixa orellana,* might be of interest.

At least two pigments have been isolated from the seeds of this plant. Bixin, the better known of the two, has been much studied and we owe a knowledge of many of its chemical and physical properties to the researches of Marchlewski[2] in 1907.

Since that time many papers have appeared dealing with its chemical structure and properties, but Euler and Euler[3] in 1929 were apparently the first to test its physiological activity, which they reported as being negative. Palmer[4] in his monograph states that bixin does not belong to the group of carotinoid pigments, and therefore might reasonably be expected to be inactive in this respect. Palmer does not mention the less known pigment orellin, which accompanies bixin, and it is the latter material that is the basis of the present investigation.

If the crude red powder (annatto) obtained from fresh seeds of Bixa Orellana is extracted with cold 80 to 90 per cent. alcohol, a deep reddish-brown solution results, which on evaporation leaves a dark-colored, sticky, resinous material. It is in this fraction (practically bixin-free) that the vitamin A activity resides. When an alcoholic solution of this resinous material containing orellin is fed to rats on a vitamin A-free diet, at such a level that they receive 3 mg of dissolved solids per day, their rate of growth corresponds to that recommended by Sherman[5] in his quantitative estimation of this vitamin. So far as the semi-quantitative results show at present, the seeds yield 2 per cent. of this active material. This places

[1] From the School of Tropical Medicine of the University of Porto Rico under the auspices of Columbia University, San Juan, Porto Rico. This research was made possible by a grant from the Rockefeller Foundation.

[2] L. Marchlewski, *Biochem. Z.*, 3, 286, 1907.

[3] Beth v. Euler and Hans v. Euler, *Helv. Chem. Acta.*, 12, 278, 1929.

[4] L. S. Palmer, "Carotinoids and Related Pigments." Chem. Monograph Series, 1st ed., 22, 1922.

[5] H. C. Sherman and H. E. Munsell, *Jour. Amer. Chem. Soc.*, 47, 1639, 1925.

annatto among the richest vegetable sources of vitamin A thus far reported.

It is unknown at this stage of the investigation whether we are dealing with vitamin A as such, carotin or some related pigment, or a new substance which can function as vitamin A in the animal body.

A preliminary experiment of feeding bixin obtained from annatto that had had the active resinous coloring material removed by alcoholic extractions confirmed Euler's finding in that it did not cause growth in rats on an A-free diet. There is some indication that bixin may exert a toxic action on the organism.

Further work is in progress on this interesting development.

D. H. COOK
JOSEPH AXTMAYER

A NOTE ON THE EFFECT OF ULTRA-VIOLET LIGHT ON THE VITAMIN A OF BUTTER

ZILVA[1] has shown that vitamin A is destroyed by ultra-violet light when exposed in air but not in a carbon dioxide atmosphere. Spinka[2] found that ultra-violet radiations did not destroy vitamin A, but that toxic materials were formed which were sufficient to cause death in rats. His animals succumbed before the controls on a vitamin A free diet developed the typical symptoms of vitamin A deficiency.

The fact that radiations other than ultra-violet light[3] destroy the vitamin A of butter suggested that the mechanism might be of a photochemical nature.

Butter fat was exposed in large flat dishes to the rays of the quartz mercury arc at a distance of 15 cm. for 6 hours. At the end of 3 hours all the color of the material had disappeared. Another portion of the fat was exposed under similar conditions in an atmosphere of nitrogen which had previously been purified to free it from oxygen. No change in color was observed. These materials and the untreated butter fat were fed to rats depleted of their vitamin A stores, as follows: (1) The untreated butter fat; (2) butter fat exposed to ultra-violet light in air; (3) butter fat exposed to ultra-violet light in a nitrogen atmosphere; (4) the untreated material mixed in equal parts with the butter fat exposed to ultra-violet light in the air. Control animals received no source of vitamin A. The results are presented in Fig. 1.

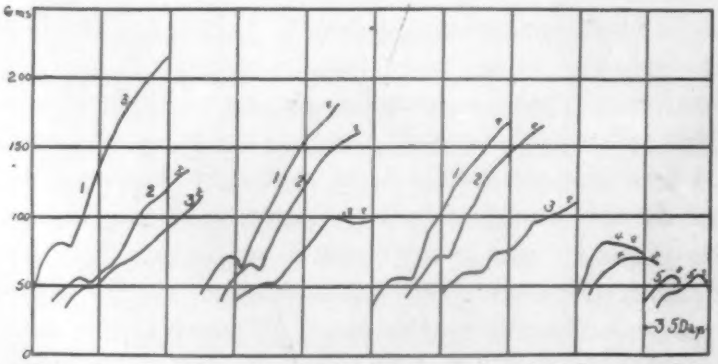

FIG. 1. Treatment. (1) 0.3 gm untreated butter fat, daily. (2) 0.3 gm butter fat irradiated in nitrogen atmosphere, daily. (3) 0.3 gm untreated butter fat plus 0.3 gm butter fat irradiated in air, daily. (4) 0.3 gm butter fat irradiated in air, daily. (5) No source of vitamin A.

RESULTS

Practically complete destruction of vitamin A potency and loss of color in butter fat was obtained when the material was exposed in air. The material exposed in a nitrogen atmosphere did not fade. Its antiophthalmic properties were not reduced in any detectable degree, although some reduction in its growth-promoting power was found.

When butter fat exposed in the air was mixed with the untreated material a definite slowing of growth was obtained as compared to that produced by untreated butter fat fed in an equivalent amount.

Negative controls and animals receiving butter fat exposed in the air succumbed at about the same time. Ophthalmia developed in both groups.

These experiments indicate that the change that takes place in vitamin A potency when butter fat fades is not due to a direct effect of ultra-violet light. Oxidation, indirectly produced by ultra-violet radiations, is at least one mode of destruction of the vitamin A of butter fat. It appears that irradiation in air and to some extent in a nitrogen atmosphere produces a principle that retards growth of rats. This principle was not of sufficient strength to cause death before the onset of vitamin A deficiency symptoms.

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H. R. KRAYBILL
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[1] S. S. Zilva, *Biochem. Jour.*, 13: 164, 1919: 14, 740, 1920.

[2] J. Spinka, *Biochem. Ztschr.*, 153, 197, 1924.

[3] A. G. Hogan, C. L. Shrewsbury and J. F. Breckenridge, *Jour. Biol. Chem.*, 87, p. xlii, 1930.

BOOKS RECEIVED

ALEXANDER, F. MATTHIAS. *The Use of the Self.* Pp. xix + 143. Dutton. $2.00.

HOBSON, E. W. *The Theory of Spherical & Ellipsoidal Harmonics.* Pp. xi + 500. Cambridge, Macmillan. $11.50.

LOWRY, T. MARTIN. *Inorganic Chemistry.* Second edition. Pp. xv + 1101. 282 figures. Macmillan. $8.40.

NEEDHAM, JOSEPH. *Chemical Embryology.* Volume I: Pp. xxii + 613. Figures 1–104. Volume II: Pp. xvi + 614–1254. Figures 105–401. Volume III: Pp. xvi + 1255–2021. Figures 402–532. Macmillan. $35.00 for the set.

WILSON, W. *Theoretical Physics.* Volume I. Pp. x + 332. Dutton. $6.00.

WRIGHT, ALBERT H. *Life-Histories of the Frogs of Okefinokee Swamp, Georgia.* Pp. xv + 497. 65 plates. Macmillan. $8.00.